

DDD from a surgeon's perspective

Tony Tannoury, MD

Chief of Spine Surgery

Director of Fellowship Program

Boston University

Work Related Injuries Workshop
March 25th & 26th 2019



Disclosures

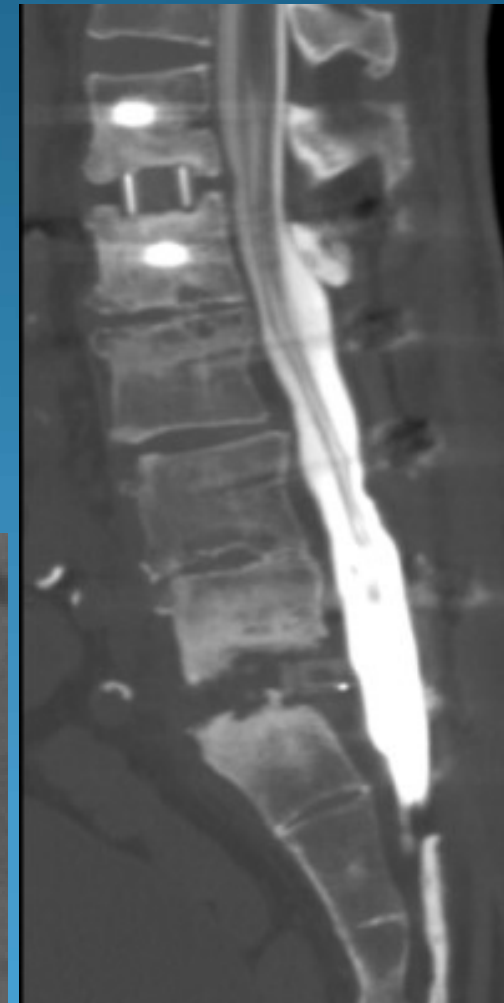
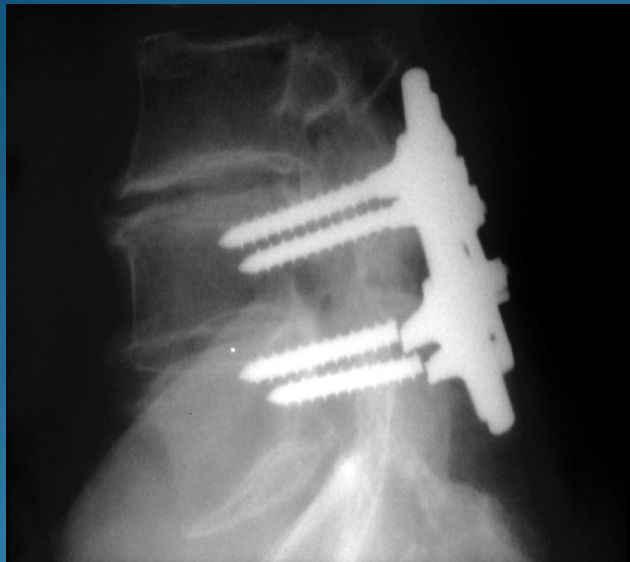
- Depuy, J&J:
 - Consultant
 - Royalty
 - Education Support
- Lippincot
 - Royalty



First Dictum

Primum Non Nocere

Complications



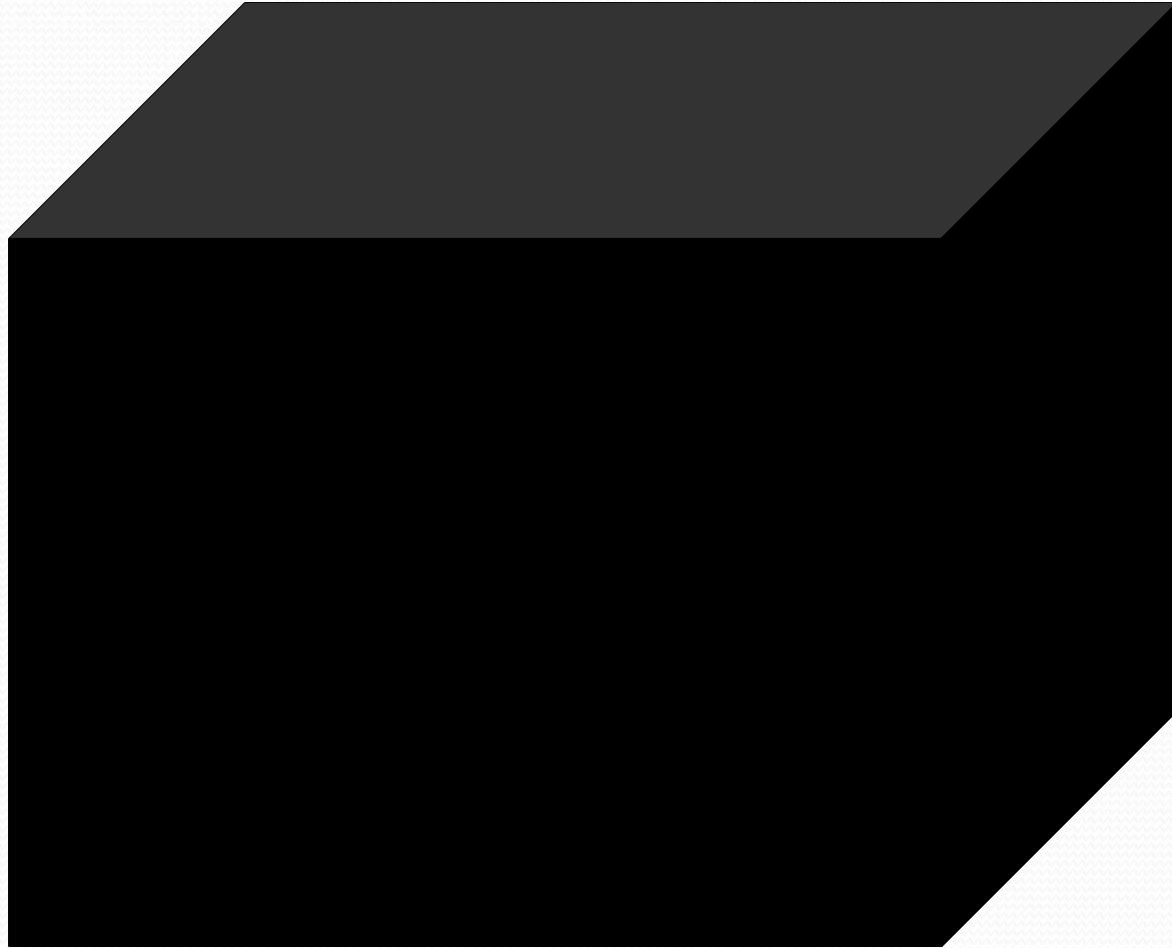
complications

- Mechanical
Technical Errors

- Lack of clinical understanding
 - **technical errors**
- Neurological
 - Technical
 - Disease/host related
- infection

- Misplaced hardware
- Inadequate sagittal and Or Coronal balance
- Inadequate decompression
- Inadequate fusion

Back pain = The Black Box



DDD

tumors

HNP

Ilary gains

Degen. scoliosis

SPONDYLOLISTHESIS

Assessment of Patient with Lumbar Complaint

- History
- Physical Exam
- Directed Imaging Studies



- Diagnosis



- Therapeutic Modalities

History

- Symptom location/character
- Duration
- Aggravating/alleviating mechanism
- Constitutional Symptoms
- Neurologic complaints



Imaging Studies

- Plain radiographs
- MRI
- CT myelography
- T⁹⁹ bone scanning



Ideal Situation

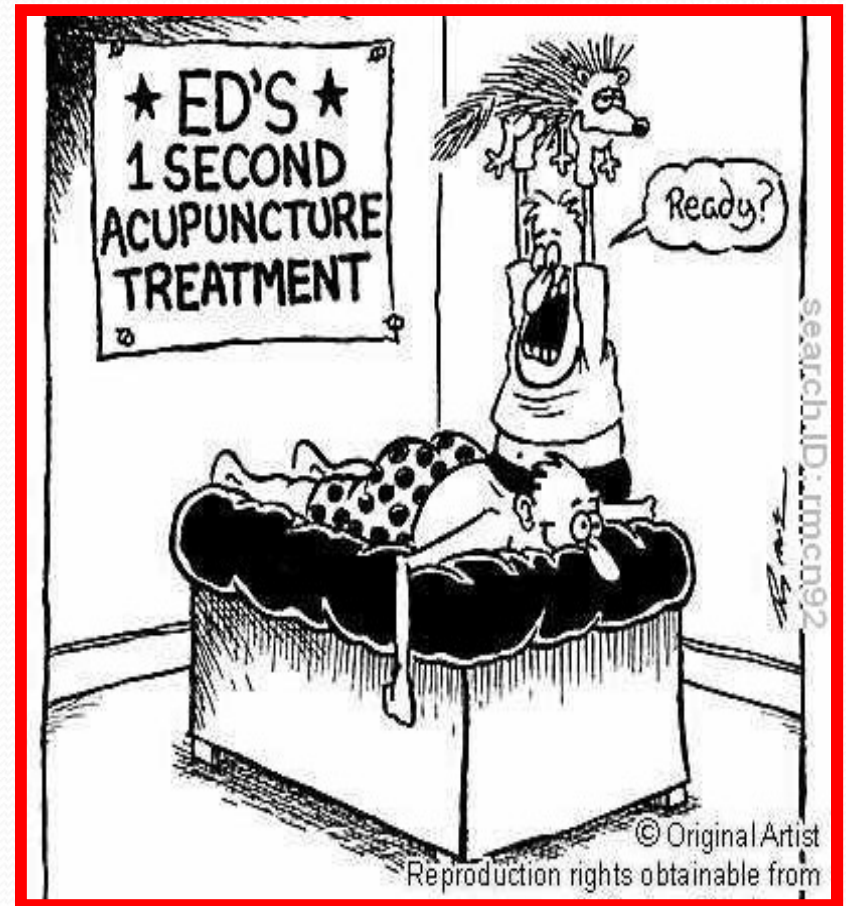
Clear Diagnosis



Treatment Plan

Goals

- Early functional restoration
- Efficient use of diagnostic studies
-
- Avoidance of unnecessary therapeutic interventions
- Avoid missing treatable diagnosis



The background of the slide is a solid blue color. At the top, there are several thin, wavy lines in shades of blue and teal that sweep across the width of the slide, creating a sense of movement or a horizon line.

REALITY IS DIFFERENT

*Work Related Injuries Workshop
March 25th & 26th, 2019*

DDD is not a disease

OUR GREY HAIR INSIDE

WILL CONTINUE TO
PROGRESS IN INTENSITY
AND LOCATION

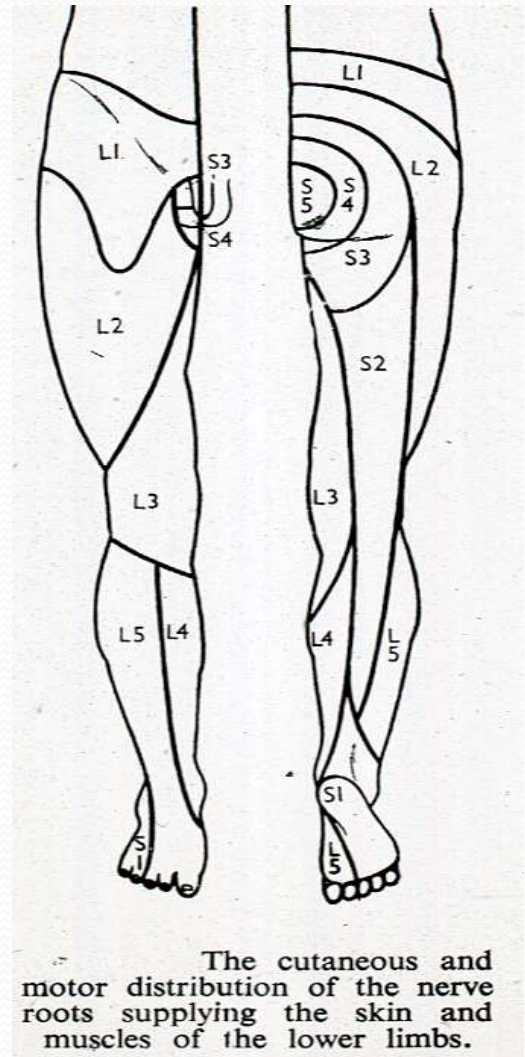
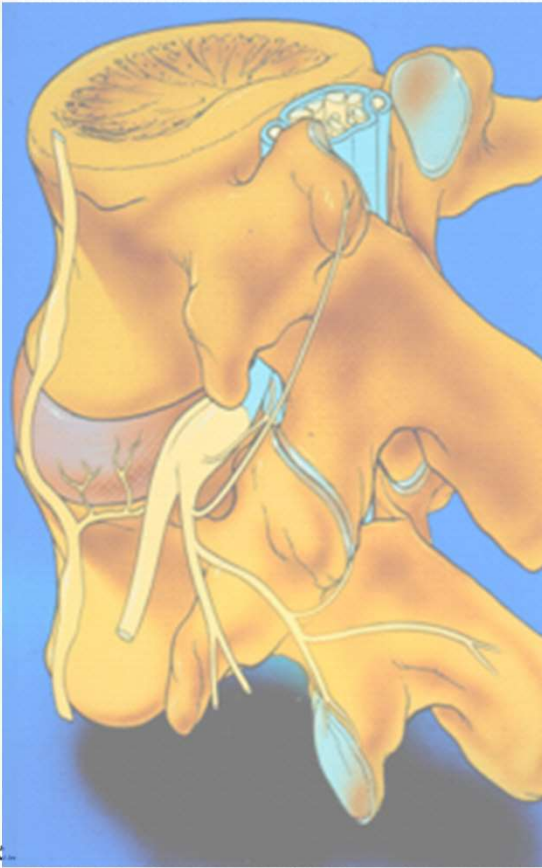
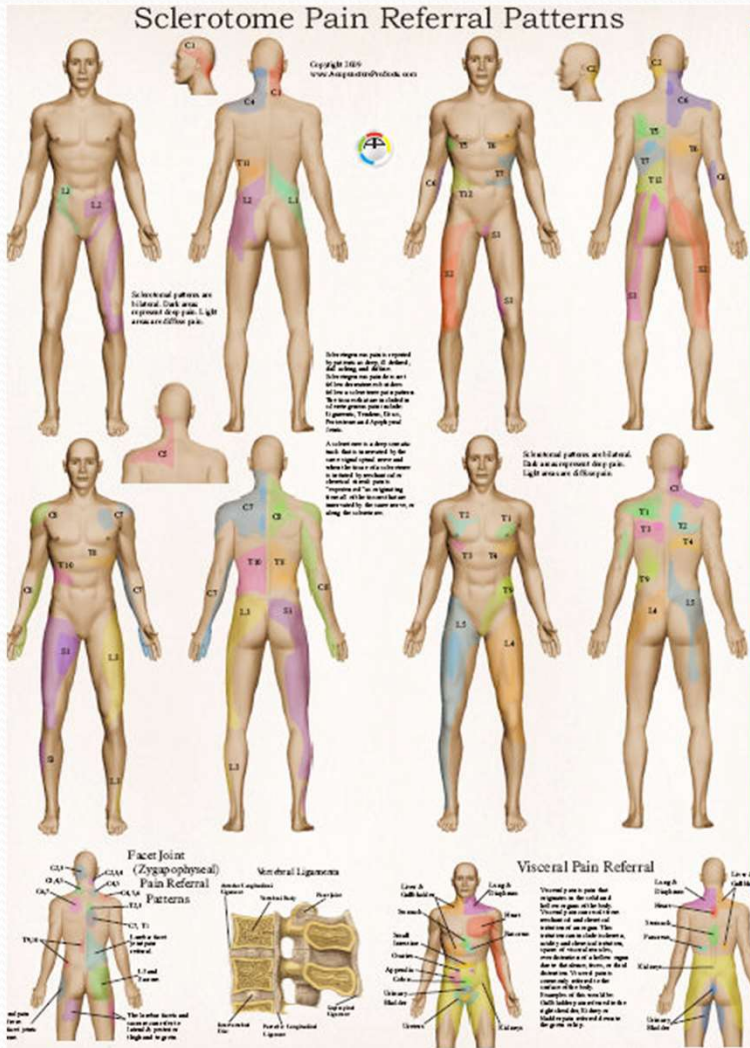


Pain Generators

- Facet joint
- Discs
- Isthmic defect?
- Muscles?
- Nerve roots
- PLL
- Dura

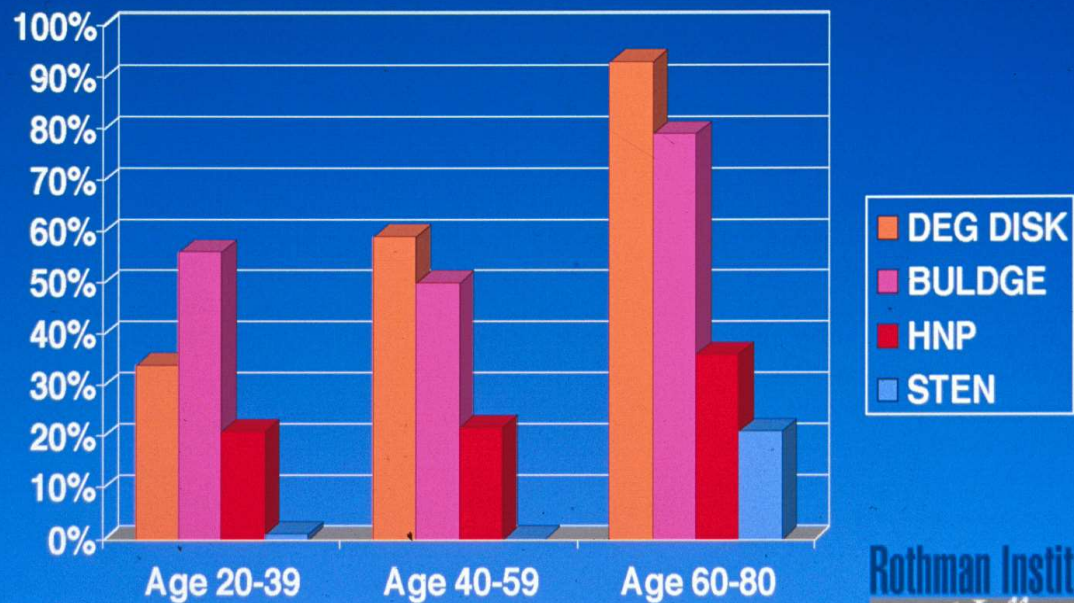


Radiculopathy & Cutaneous distribution of nerve roots



MRI Studies

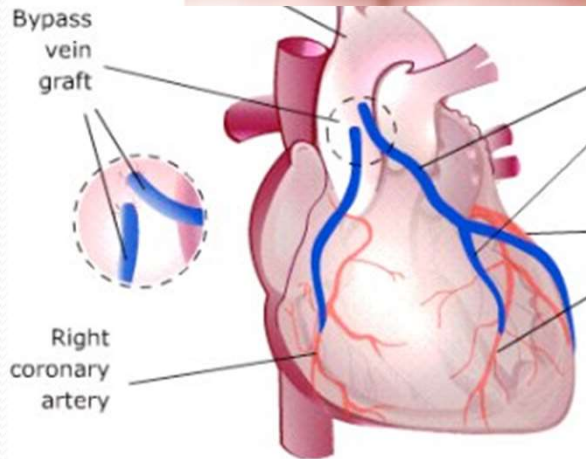
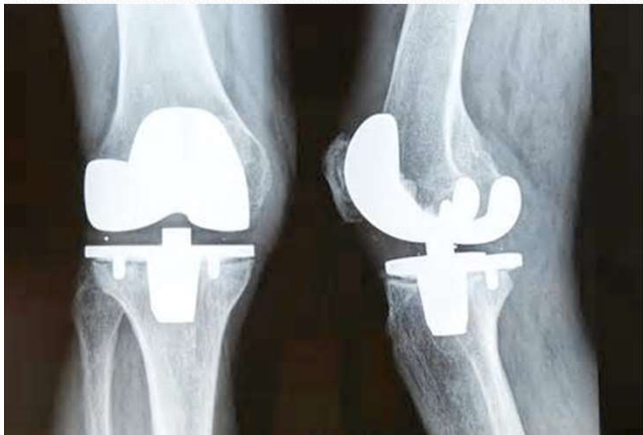
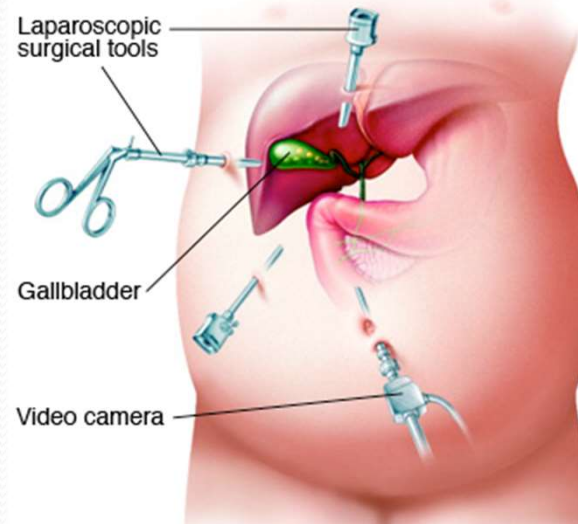
FINDINGS IN ASYMPTOMATIC SUBJECTS



Rothman Institute
at Jefferson



Unfair Benchmarks



You're treating
100% of the pathology

TREATMENT RESULTS

=

ACCURATE DX

+

APPROPRIATE PROCEDURE

APPROPRIATE PROCEDURE

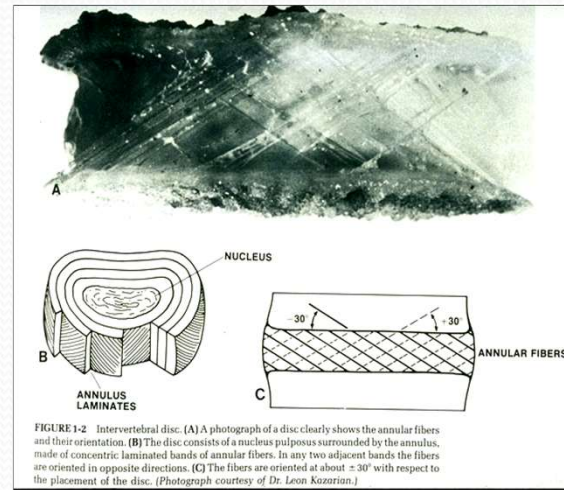
- Address the pain source
 - Compressed nerve
 - instability
- Least amount of collateral damage
 - Immediate complications:
 - Infections
 - Misplaced hardware
 - Nerve injuries
 - Etc...
- Optimize the success of future surgeries

How to improve results

- Understand biomechanics
 - Understand Mechanical principles
 - Cross training: the pain medicine Docs ↔ Surgeons
- Treat the entire disease
- Reduce complications
- Discuss expectations with patient

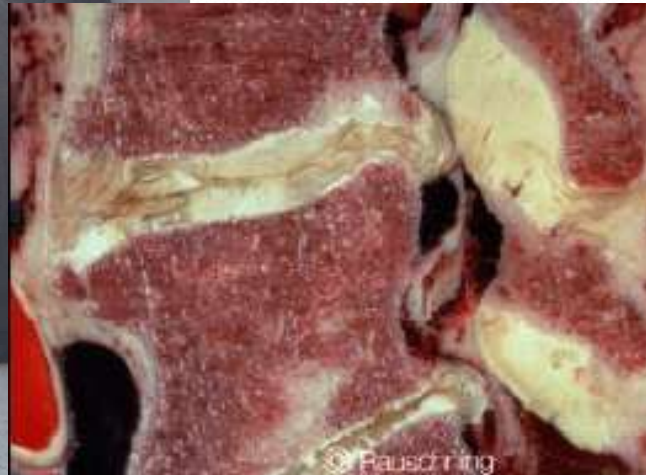
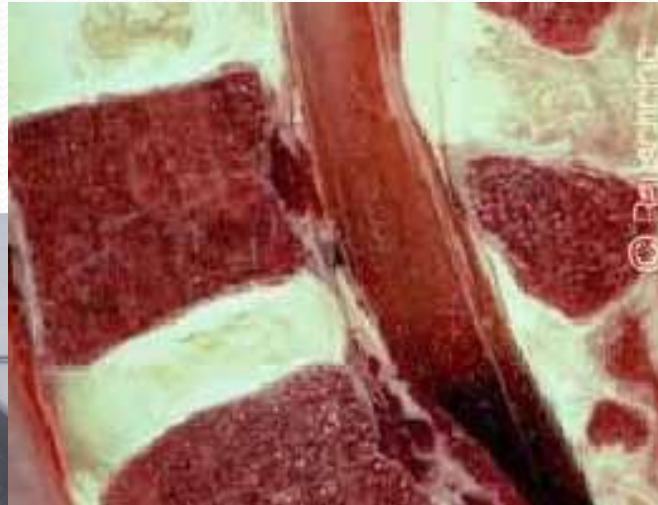
BIOMECHANICS

- Disc Pressure
- Spinal Alignment
 - Local level
 - General level



Disc Degeneration

- Loss of cells
 - ↓ Proteoglycans
 - ↓ H₂O
 - ↓ Type II/↑Type I, III collagen
- Development of annular fissures
- Loss of mechanical competence
- Endplate changes/
Osteophytes Formation



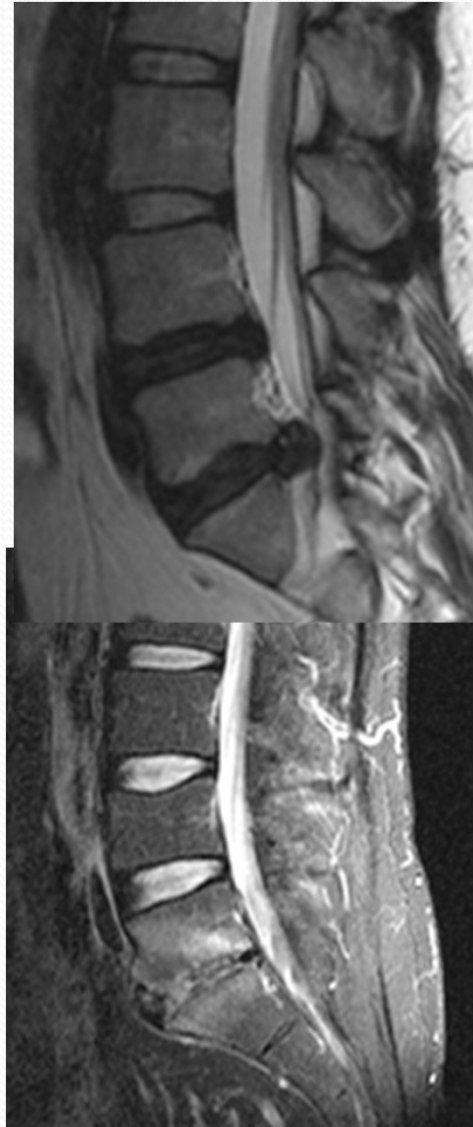
Rauschning



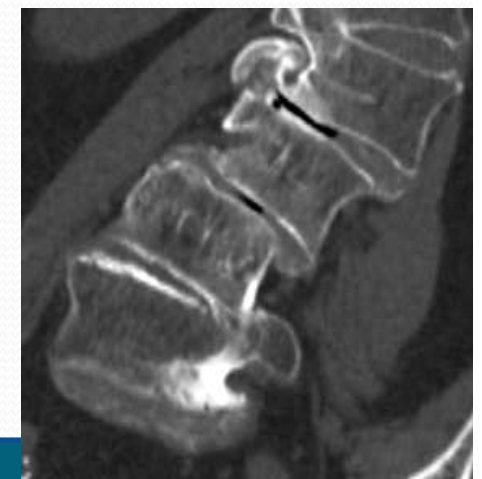
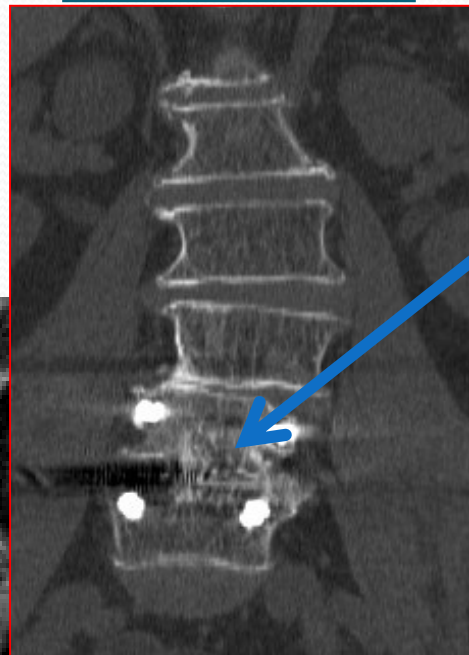
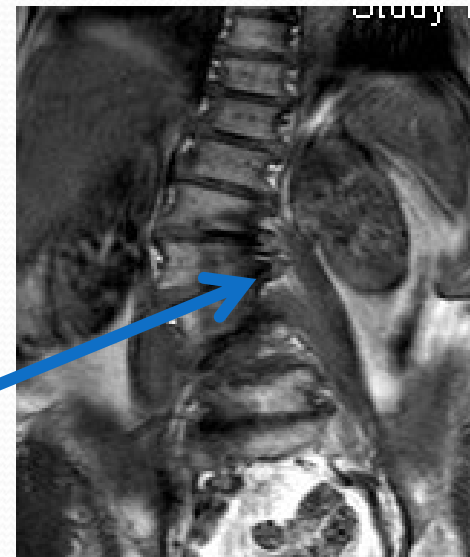
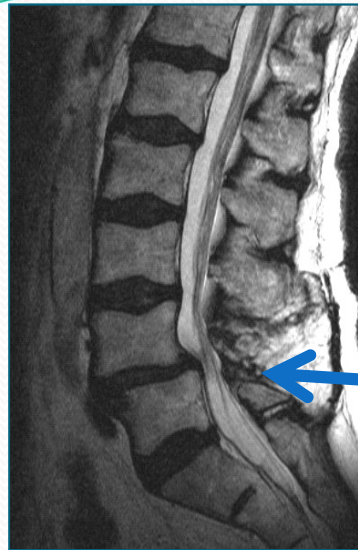
Low Pressure Disc: ESI will Not help Discectomy would not help



LEAST understood Instability: Axial



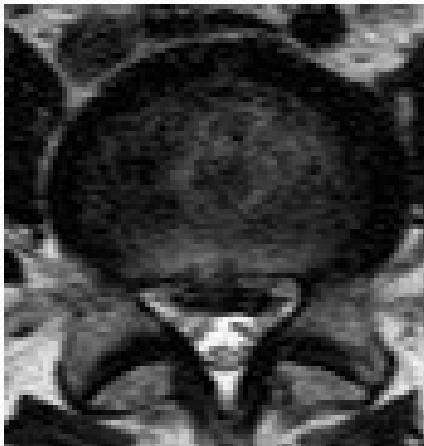
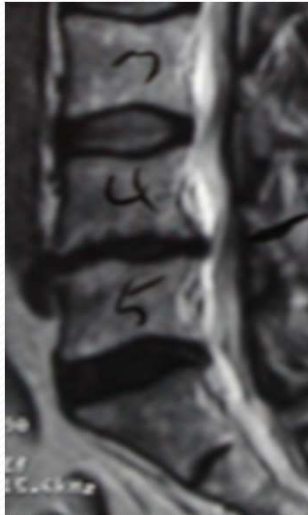
Axial Instability= Origin of ALL instabilities



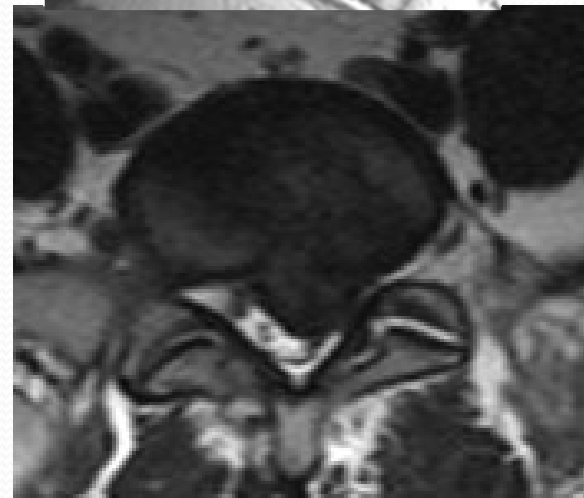
Treatment Recommendations

Types of HNP

Circumferential Disc bulge



True Disc herniation

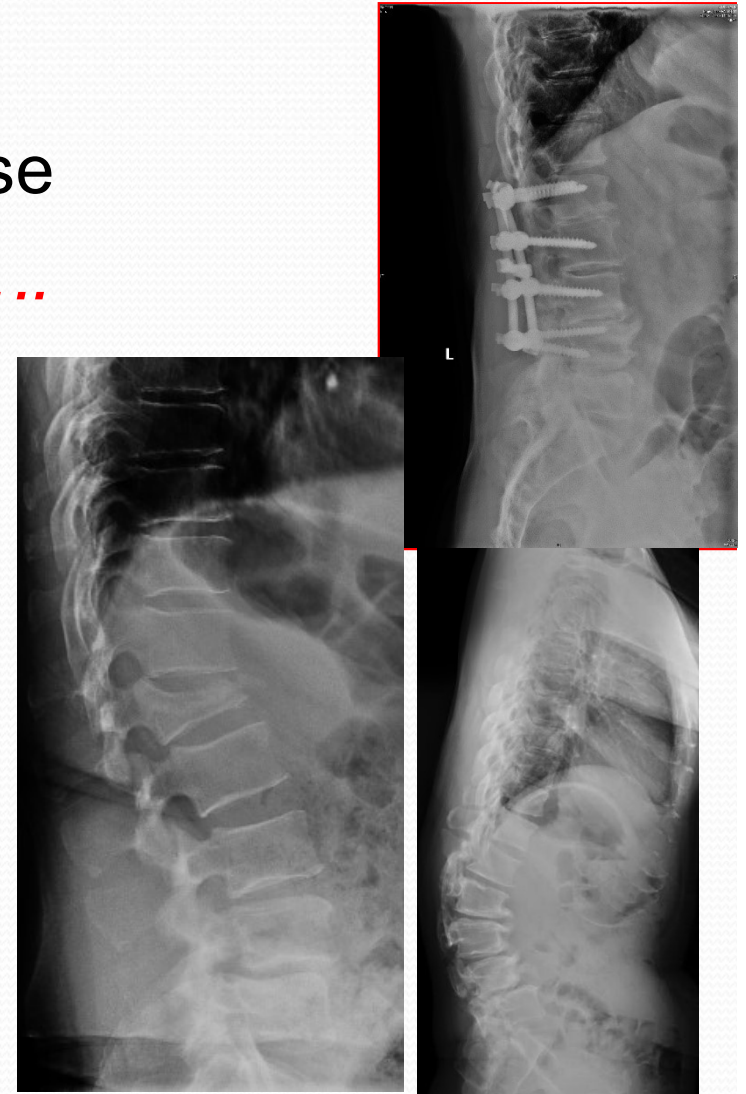


Sagittal imbalance

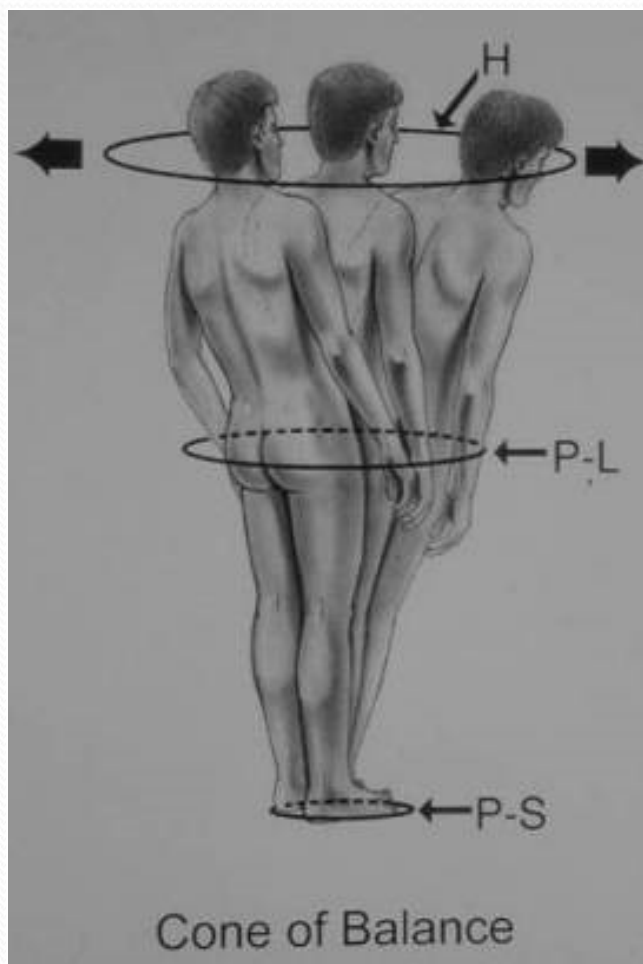
- Multilevel degenerative disc disease

Life is a Kyphosing Event

- Post-Traumatic Kyphosis
- Iatrogenic – Post fusion (Flat Back Syndrome)
- Ankylosing spondylitis, kyphoscoliosis



Why is Alignment Important ?

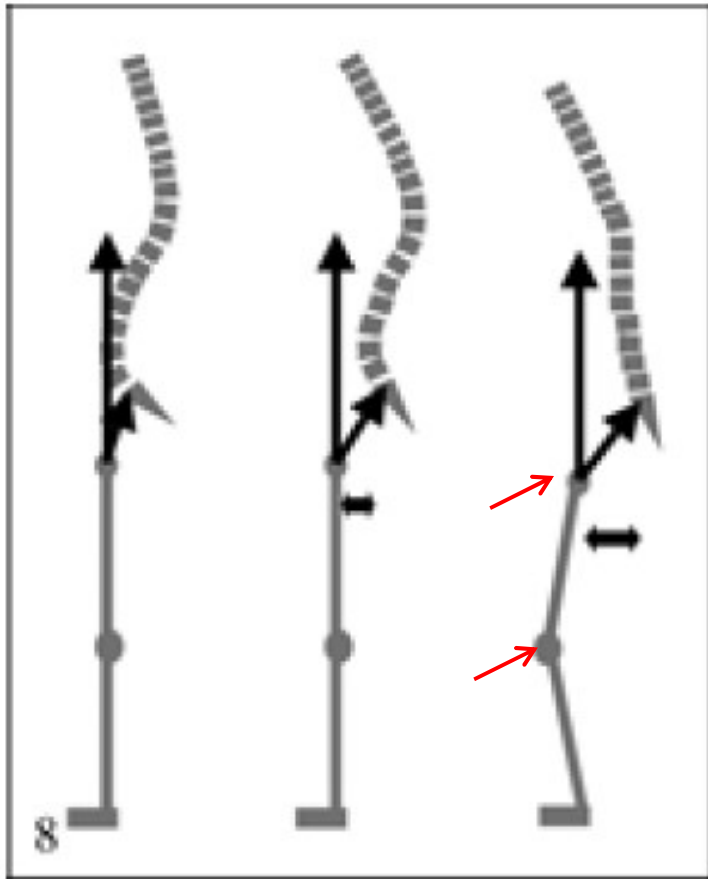


Jean Dubousset

Poor alignment = disability

- Must compensate for anatomic deformation
- Mechanical disadvantage challenges balance mechanisms

**Deviation from stable zone =
Increase Muscular / energy use**

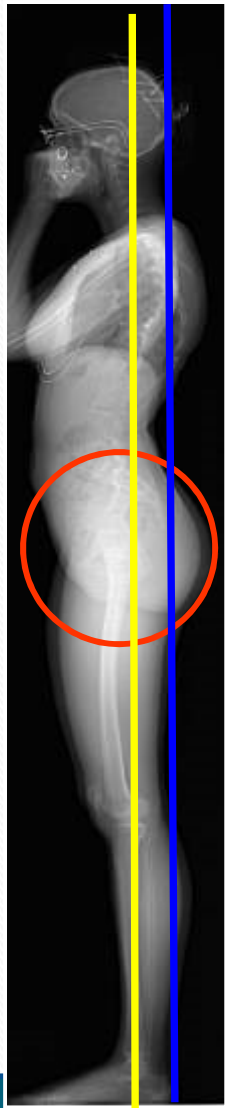


Compensation

↓ SS (Lumbar Kyphosis) → ↑ PT

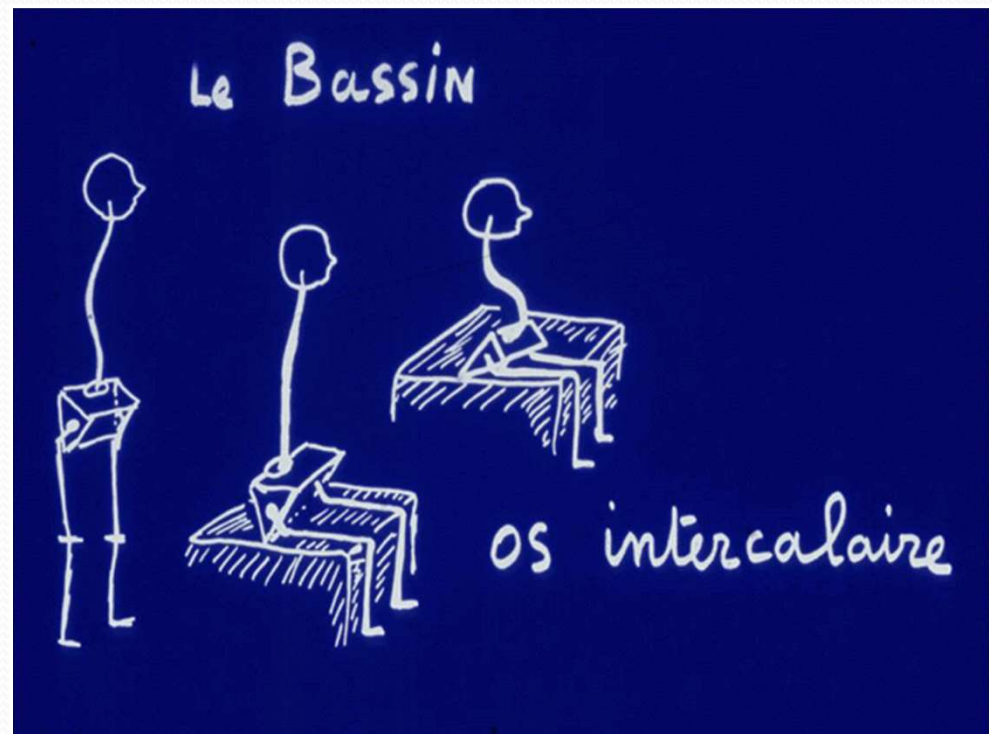


Alignment... More Than Just the Spine



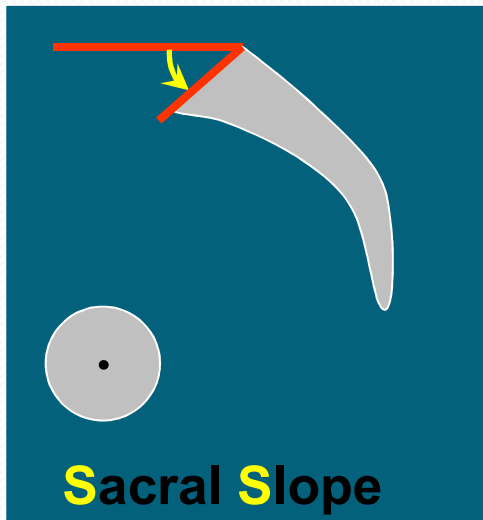
**Regulator of
Alignment
Link between
Above and
Below**

The 'Pelvic Vertebra'
J Dubousset



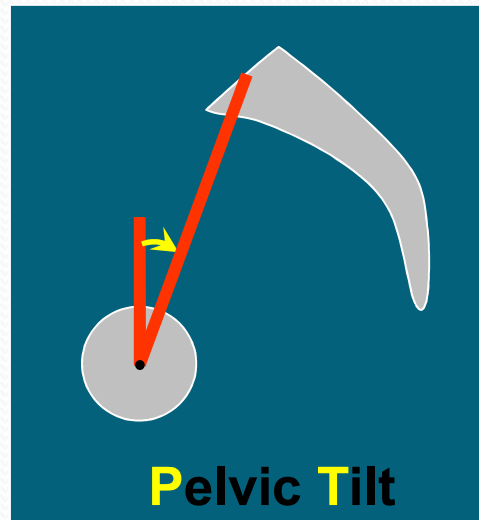
Pelvic Parameters

Duval Beaupere, Vidal, Roussouly, Farcy ...



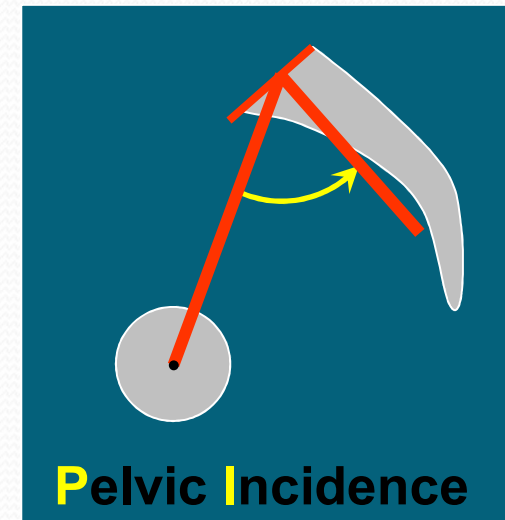
Sacral Slope

SS: 30-50°
Compensatory
Parameter



Pelvic Tilt

PT: 10-25°
Compensatory
Parameter

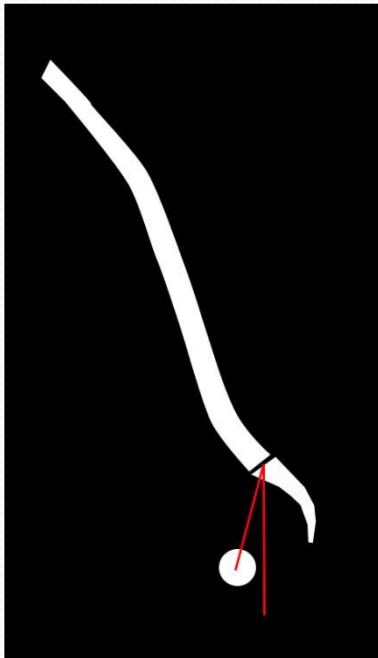


Pelvic Incidence

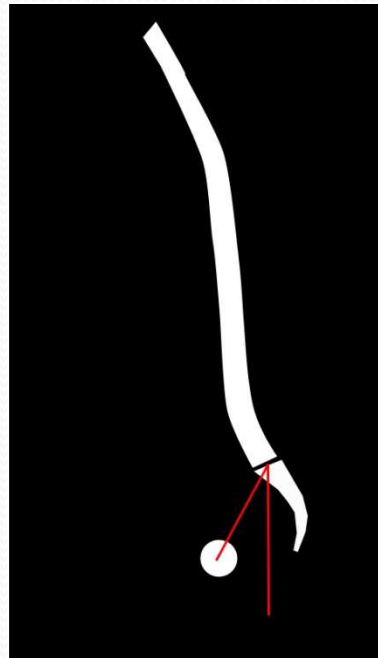
PI: 40-65°
Morphologic Parameter

$$PI = PT + SS$$

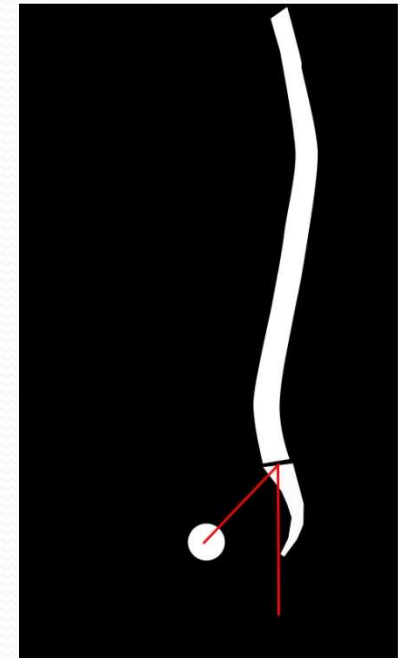
Same structural deformity ... different compensation



Large SVA, No PT



Moderate SVA / PT



No SVA, Large PT

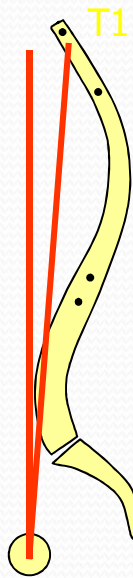
Pelvis = base of the spine, regulator of the standing posture “Pelvic Vertebra”

Spinal Alignment objectives



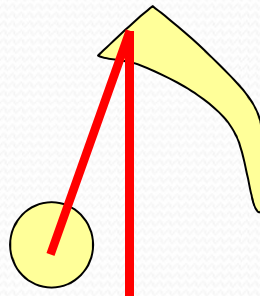
SVA

<5cm



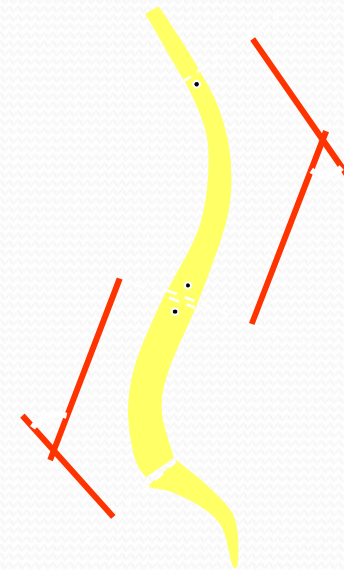
T1 Tilt

<0°



PT

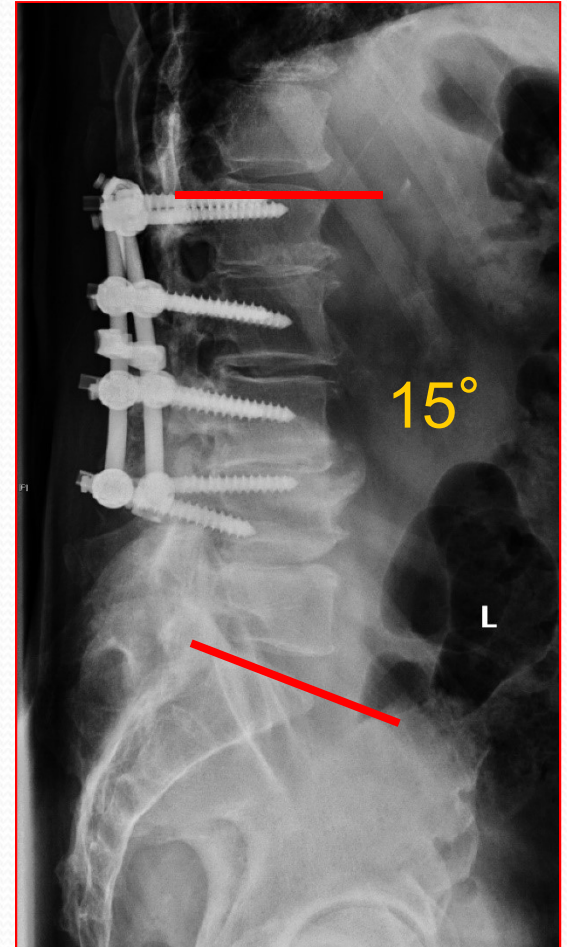
<25°



Proportional:
LL=PI +/- 9°

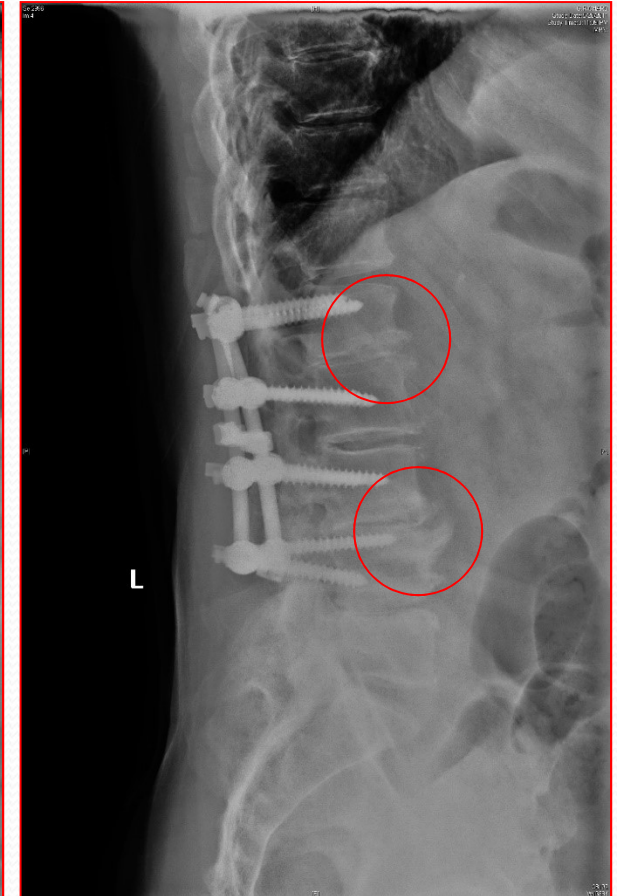
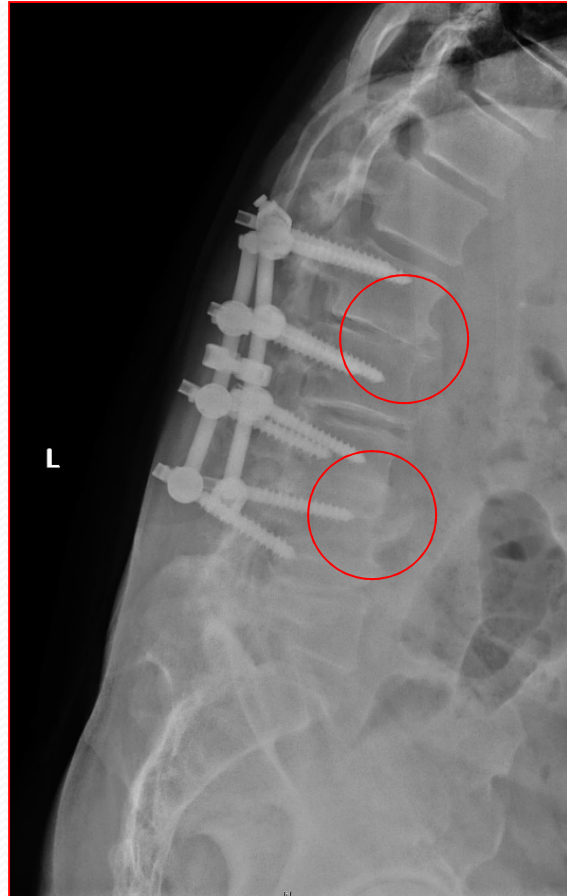
64 yo.s/p L1-L4 fusion

- Fused in “flat” Position
- Loss of normal lordosis (Superior end plate of T12 to Sup. End plate of S1 -40-60°)

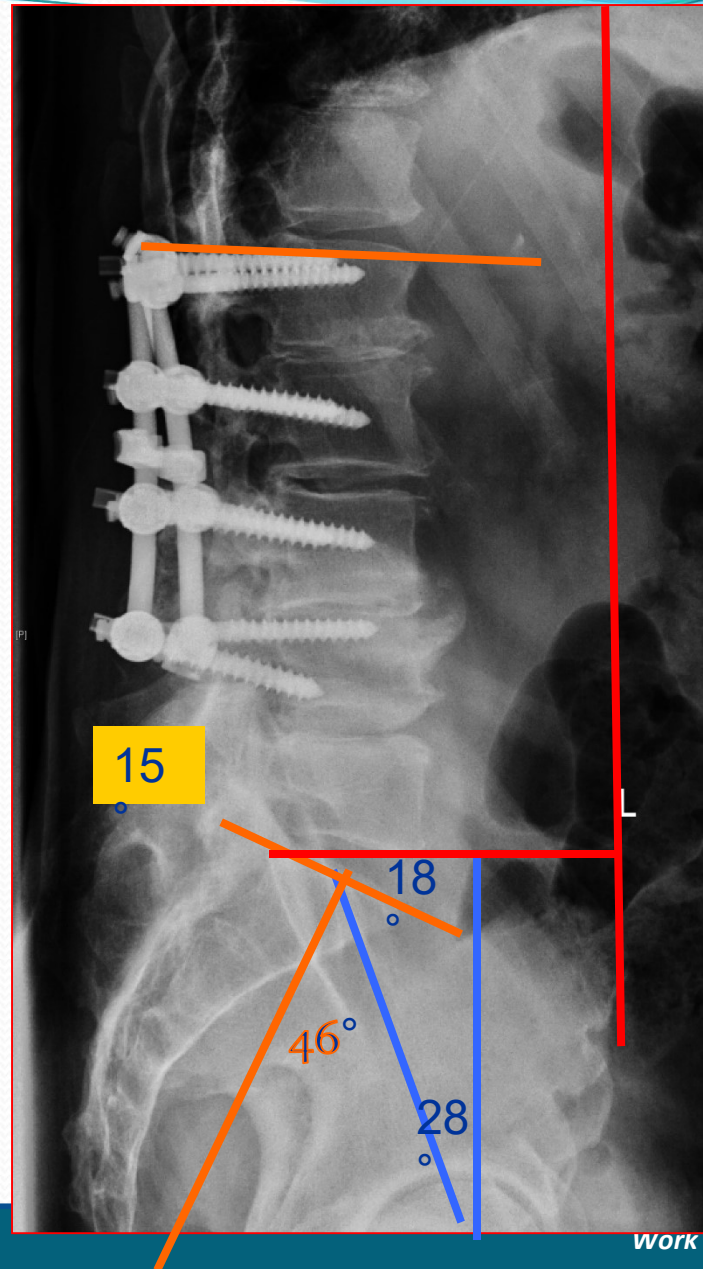


Imaging: Flex/Ext

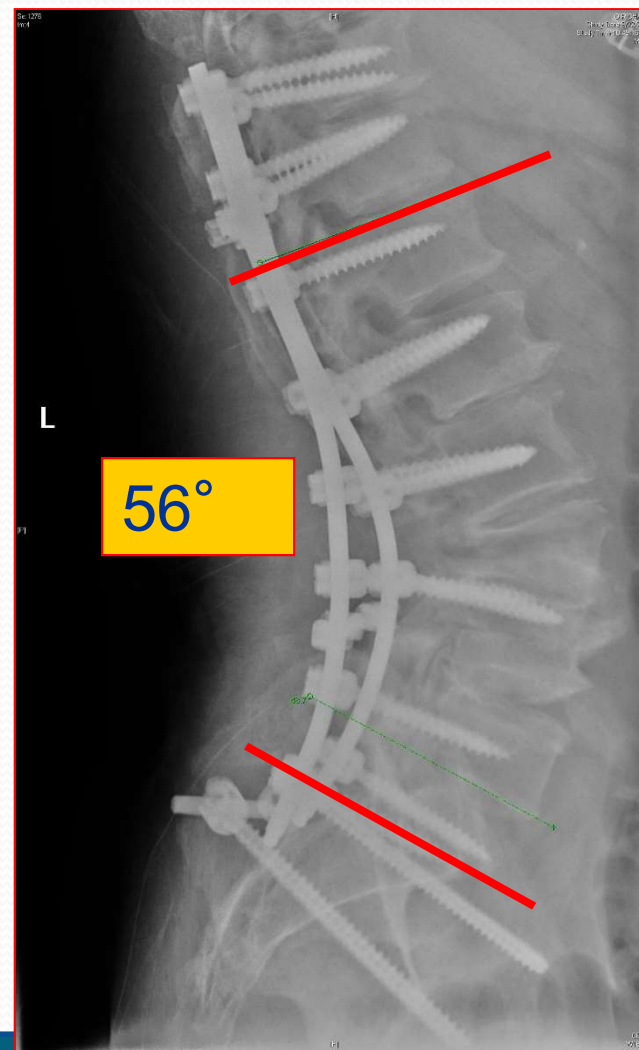
- Flexion-Extension views
- L1-L2 pseudoarthrosis
- Likely L3-L4 pseudoarthrosis
- L4-L5 adjacent disc disease



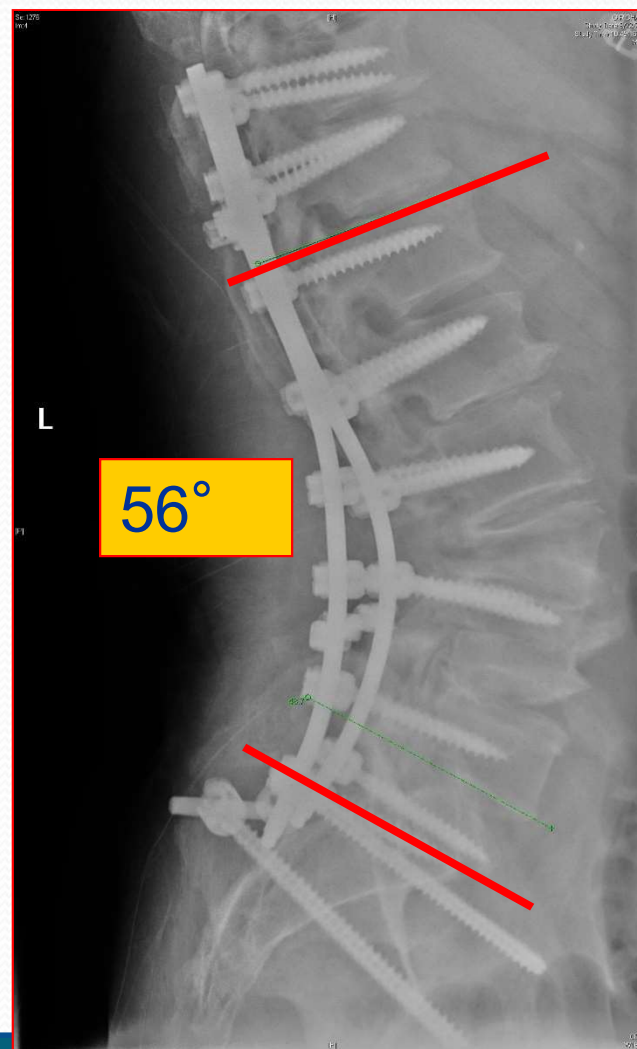
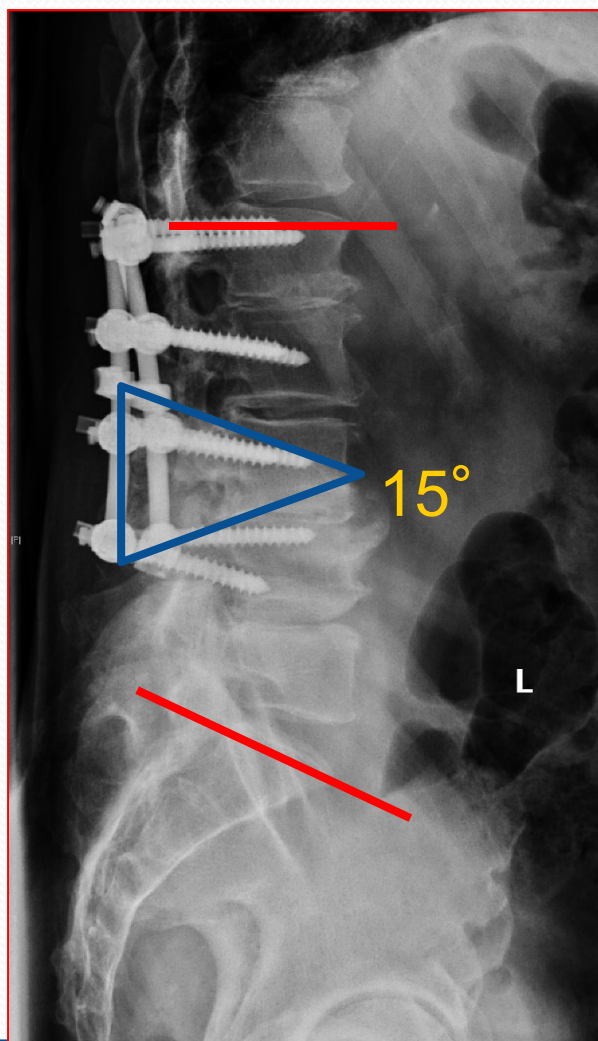
- Lumbar lordosis
- SVL (Plomb line)
- Sacral Slope
- Pelvic Tilt
- Pelvic Incidence=SS+PT= 46
- $LL = PI + 10$



Post-op X-rays

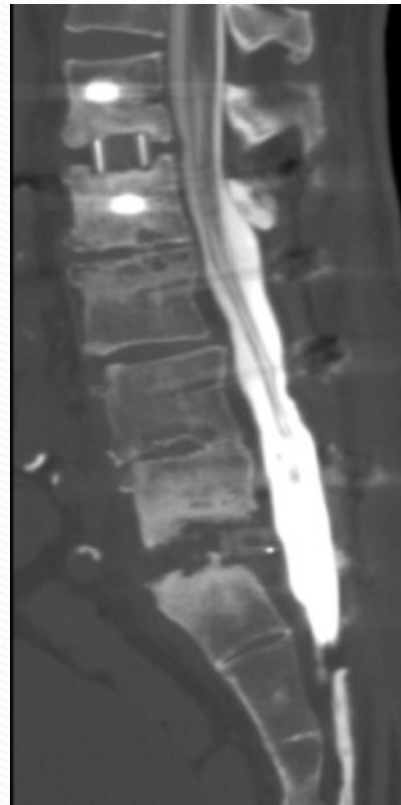
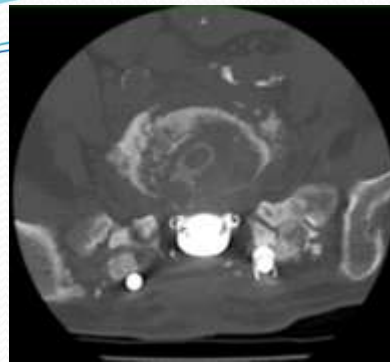


Doing Great



57 YO male, S/p Three spinal fusions





Imbalance



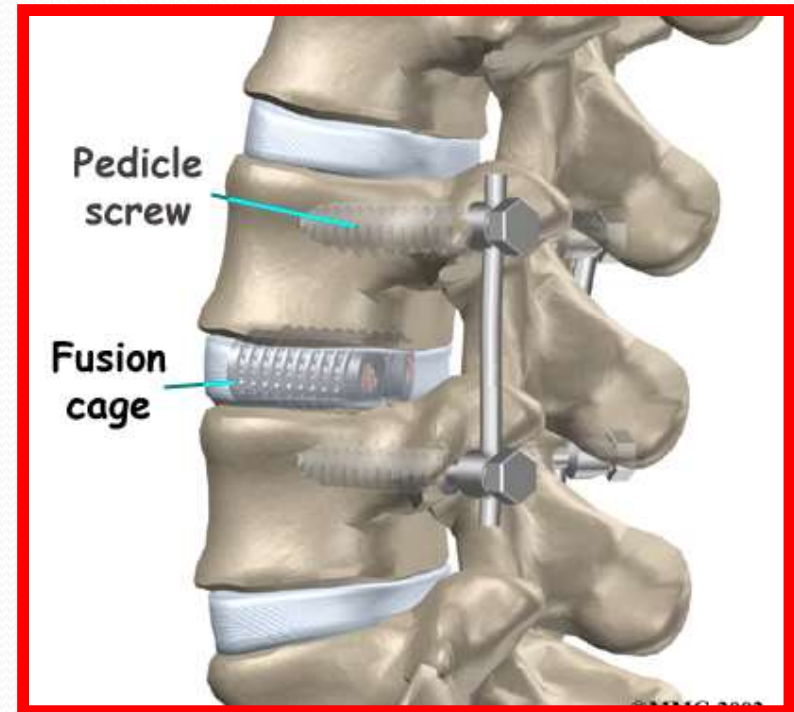
CA40205A

42

Work Related Injuries Workshop
March 25th & 26th, 2019

Adjacent Disc Status S/P Spinal Fusion

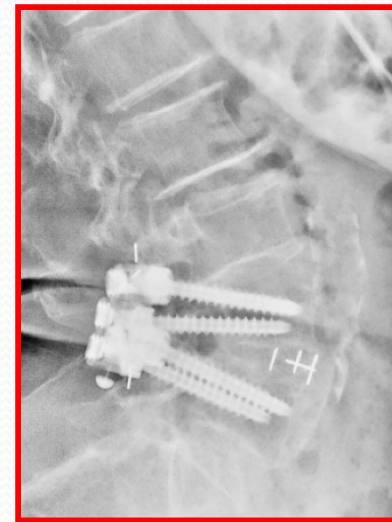
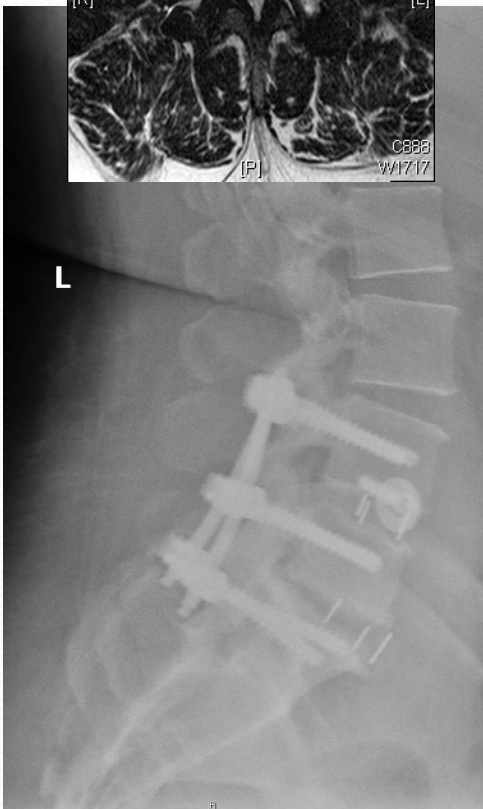
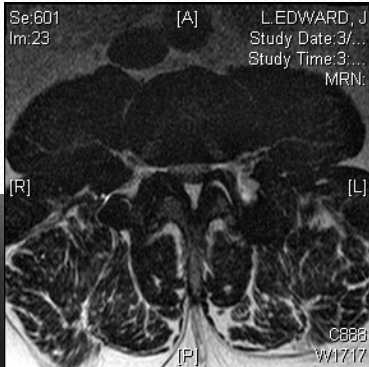
- Fusion is designed to reduce the motion at the operative level



Adjacent Segment Disease

=

Disc Disease at the disc above or below fused segment

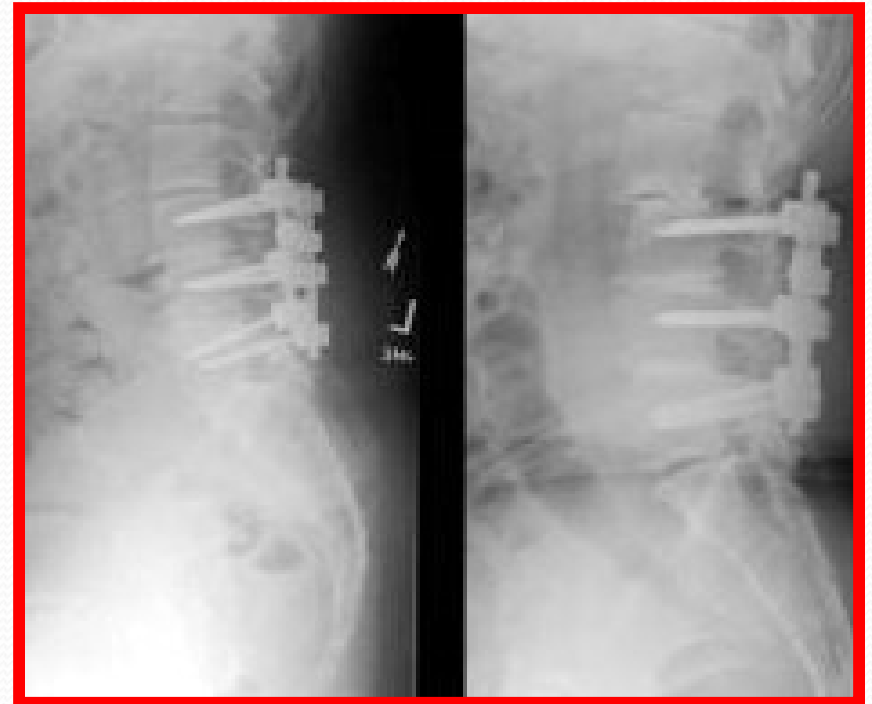


J Spinal Disord. 1996 Oct;9(5):392-400.

Adjacent-segment degeneration after lumbar fusion with instrumentation: a retrospective study.

Rahm MD, Hall BB.

- 5 year follow up
- 49 patients s/p posterior lumbar fusion
- 35% ASD
- Worse subjective outcome
- Pseudarthrosis protective



ADJACENT SEGMENT DEGENERATION IN THE LUMBAR SPINE

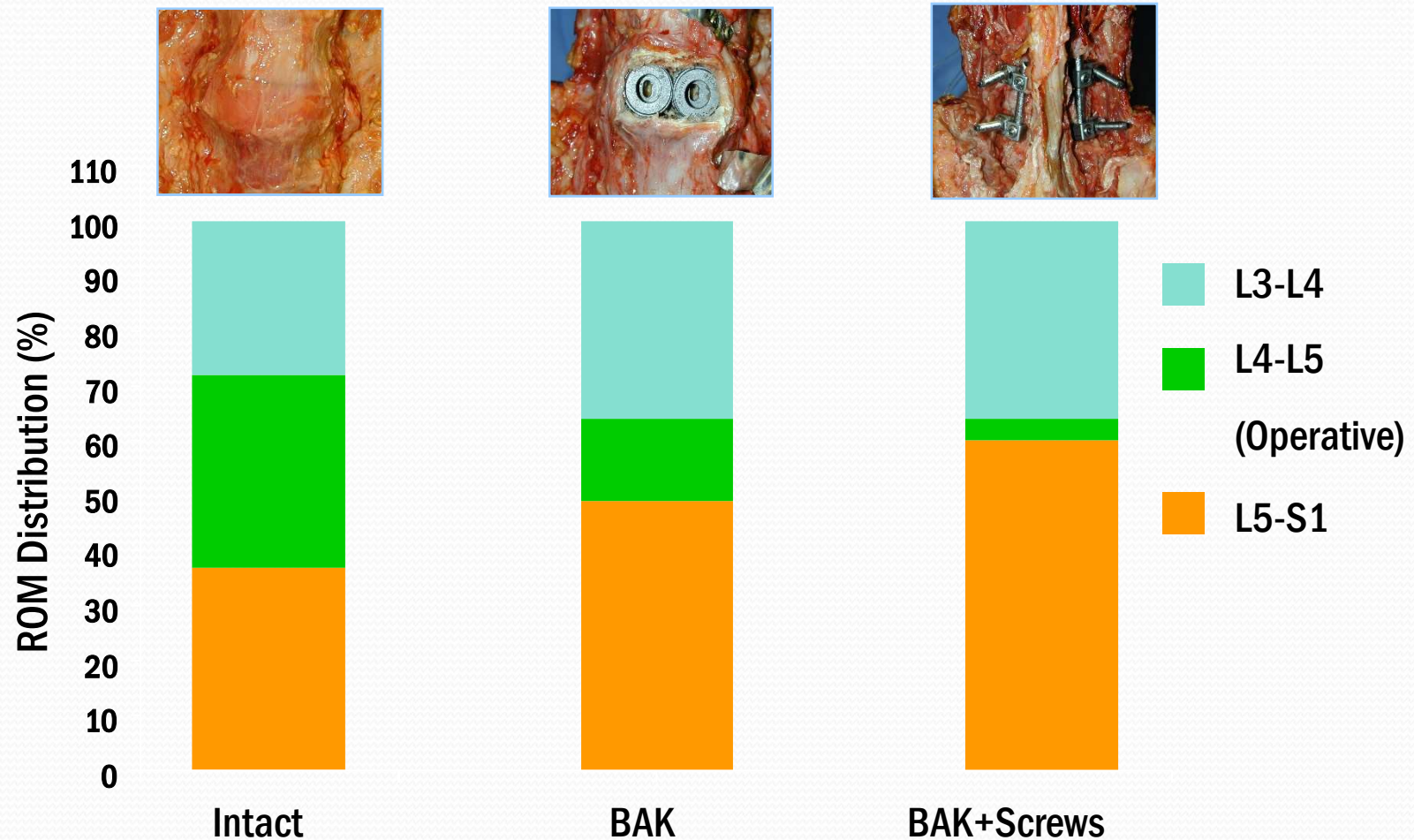
BY GARY GHISELLI, MD, JEFFREY C. WANG, MD, NITIN N. BHATIA, MD,
WELLINGTON K. HSU, MD, AND EDGAR G. DAWSON, MD

- 215 patients
- Avg 6.7yr follow up
- 27.4% second procedure
- No correlation with preexisting arthritis
- Single level fusion—higher risk
- Floating fusion – highest risk

Adjacent Segment Pathogenesis Theories

- Mechanical
- Iatrogenic
- Natural history of the disease

Biomechanical Behavior After L4-5 fusion



Fusion alters the biomechanics at the
operative and adjacent functional spinal
units

Work Related Injuries Workshop
March 25th & 26th, 2019

B. Cunningham, McAfee, et al: Spine 2003

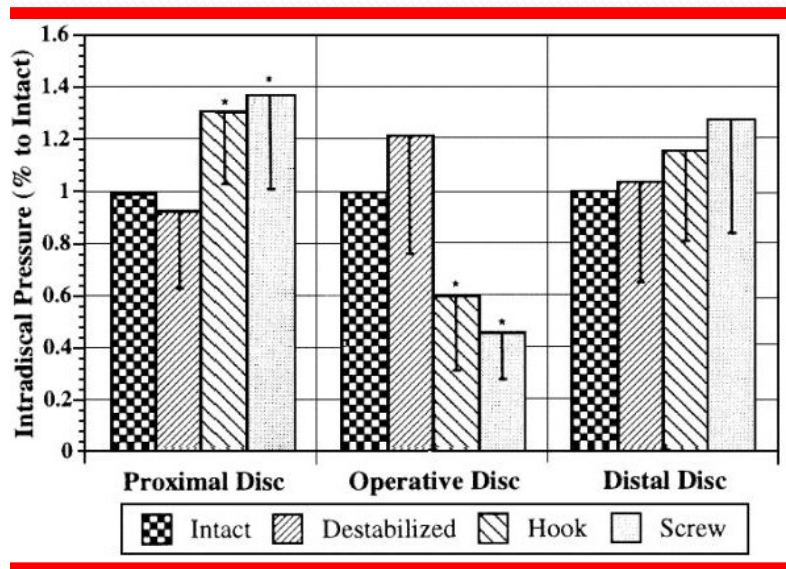
Mechanical Theory

Spine (Phila Pa 1976). 1997 Nov 15;22(22):2655-63.

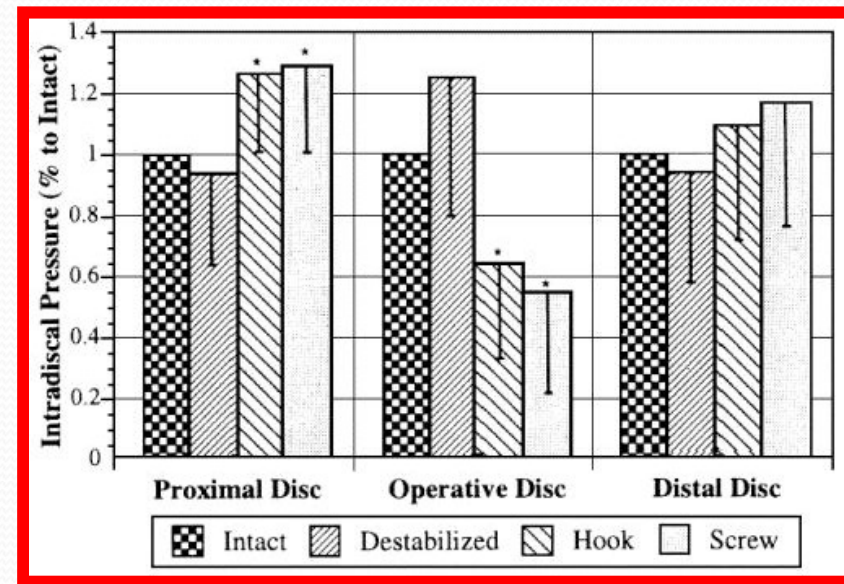
The effect of spinal destabilization and instrumentation on lumbar intradiscal pressure: an in vitro biomechanical analysis.

Cunningham BW, Kotani Y, McNulty PS, Cappuccino A, McAfee PC.

- Axial loading



- Anterior flexion loading



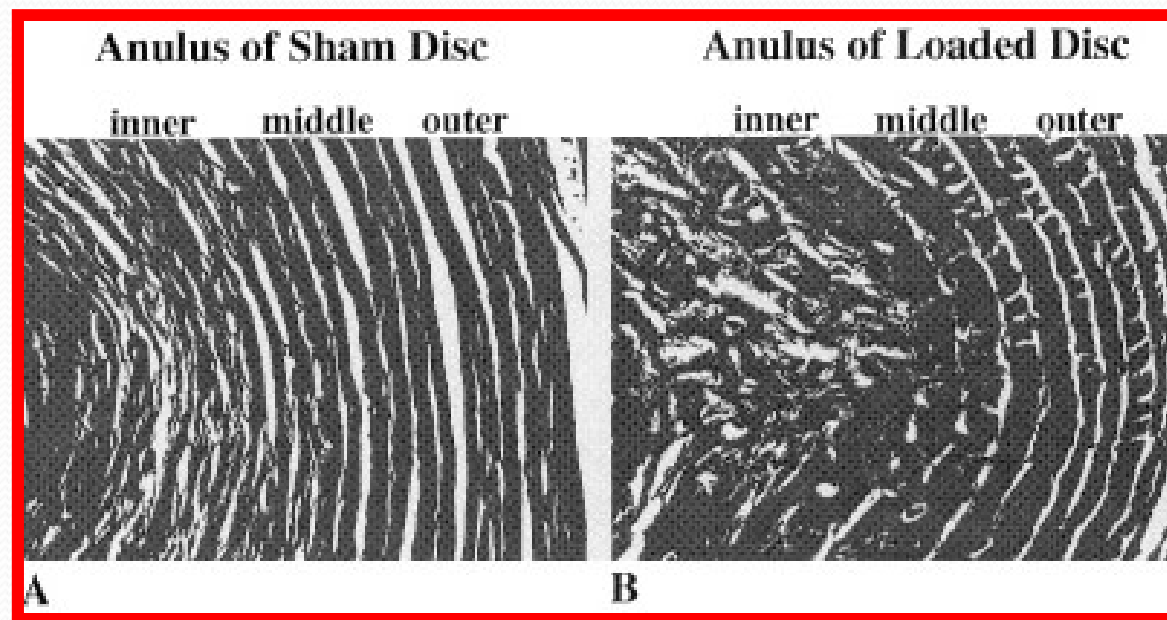
- 45% increase in disc pressure

Spine (Phila Pa 1976). 1998 Dec 1;23(23):2493-506.

Compression-induced degeneration of the intervertebral disc: an in vivo mouse model and finite-element study.

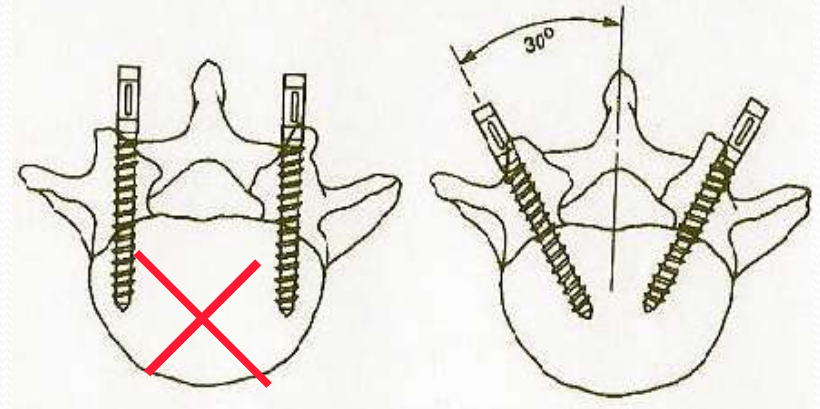
Lotz JC, Colliou OK, Chin JR, Duncan NA, Liebenberg E.

- Mouse model
- Increased disc pressure causes degeneration
- Poor recovery



Adjacent Segment Pathogenesis Theories

- Mechanical
- Iatrogenic
- Natural history of the disease



Fusion Method or Pedicle Screws: Risk Factors for Adjacent Segment Degeneration?

Fusion Method	10 Years Rate of ASD (%)
PLIF	47
ALIF	29
PLF	24
Statistical Comparisons (Chi² test)	P-value
ALIF vs. PLIF	.016
PLIF vs. PLF	.0041
PLF vs. ALIF	.083

Spinal Reserves

Adjacent Segment Disease



Aging Spine: Spinal Reserves

81 YO lady, sever back and leg pain

2008



3 years
Later

2011



SO, HOW TO REDUCE FAILED BACK SURGERY

MY APPROACH TO IMPROVE RESULTS

- Patient selection
- Mechanical Rx:
 - Mechanical problem requires mechanical treatment
- Treat the Entire Disease
- Clear patient expectations
- Careful Techniques

Patient history, Chief complaints

Each and everyone of the following "partial list of symptoms" I am presently experiencing occurred "immediately" after my 5 surgeries.

1. Impaired vision/eyesight — the result of excessive anesthesia administered, during 5 surgeries within a 5 week period.
2. "Excruciating pain" — buttocks, neck, shoulder and shoulder to elbow.
3. "Unbearable pressure" (entire torso) which intensifies when eating, to the point where I feel my belly is going ~~burst~~ rupture.
4. Light brown spotting/discharge
5. Involuntary body tremors (severe)
6. Hands tremble (at times, uncontrollably)
7. Pins & needles sensation in all 10 toes.
Left foot is always cold with 5 blue toes while right foot remains warm.
8. Voice cracks

and

23. Severe head pressure
24. Excruciating pain on top of both feet making it difficult to walk
25. Ringing in ears
26. Sharp pain middle of chest
27. Nightmares and dreams every single night the last 3 years since surgery
28. Constant falling in sleep
29. "Impossible" getting in and out of car — right side of car
"Impossible" getting in and out of bed — left side of bed
30. When lying down, ears feel on fire
31. When lying down to the leg exercises, both legs shake uncontrollably
32. Spelling skills impaired
33. Itching sensation lower right of torso when incision was made

* Because I have limited head movement, I've even had to relocate my toilet

9. "Irratic bowel habits
10. Bed wetting (seldom)
11. Urine extremely hot
12. After 1 year, I started driving again only to discover I am limited in turning my head to the left & right. Also limited, arm movement turning a steering wheel.
13. I feel every piece of metal in my back
14. Pain on right side when coughing or sneezing
15. Burning sensation on right side and back
16. Neck — audible cracks with sharp pain (very often)
17. Right side where nerves were cut and ribs removed is extremely tender to the slightest touch.
18. At times I must use a cane, because my walk and balance (equilibrium) is unstable.
Because of this I experienced two extremely bad falls both resulting in an unconscious

19. Both legs buckle when trying to stand, after sitting for any length of time.
Both legs buckle or cluck when seated.
20. Left leg buckles with audible cracks to knee, when walking down stairs
21. Constant hyperventilating
22. With medication (Zoloft, Buspar, Clonazepam) I am being treated for severe depression. Also, "Ultra" (pain killer)

The pressure I am experiencing on my entire right side & back is intense beyond words. I feel I am in a vice being tightened to its maximum, coupled with a feeling of being weighed down with a heavy object weight.

In my lifetime I have "never" experienced any of the problems I have mentioned (1-32). All these problems came about immediately and as a result of Dr. Batz's surgery.

In my lifetime, I have "never" experienced anyone of the problems I have described (1-32). As I mentioned in my first paragraph, all these problems came about immediately and as a result of Dr. Batz's surgery.

I want to make one point clear which I believe to be crucial to my surgery. Prior to surgery, Dr. Batz told me I was his "first" patient he was operating on with my type of Scoliosis. Dr. Batz died. I was an experimental guinea pig.

Note: Prior to surgery I had perfect health which most people can only dream about in their lifetime. Because of my disability, I am restricted from the activities I once enjoyed which were part of life.

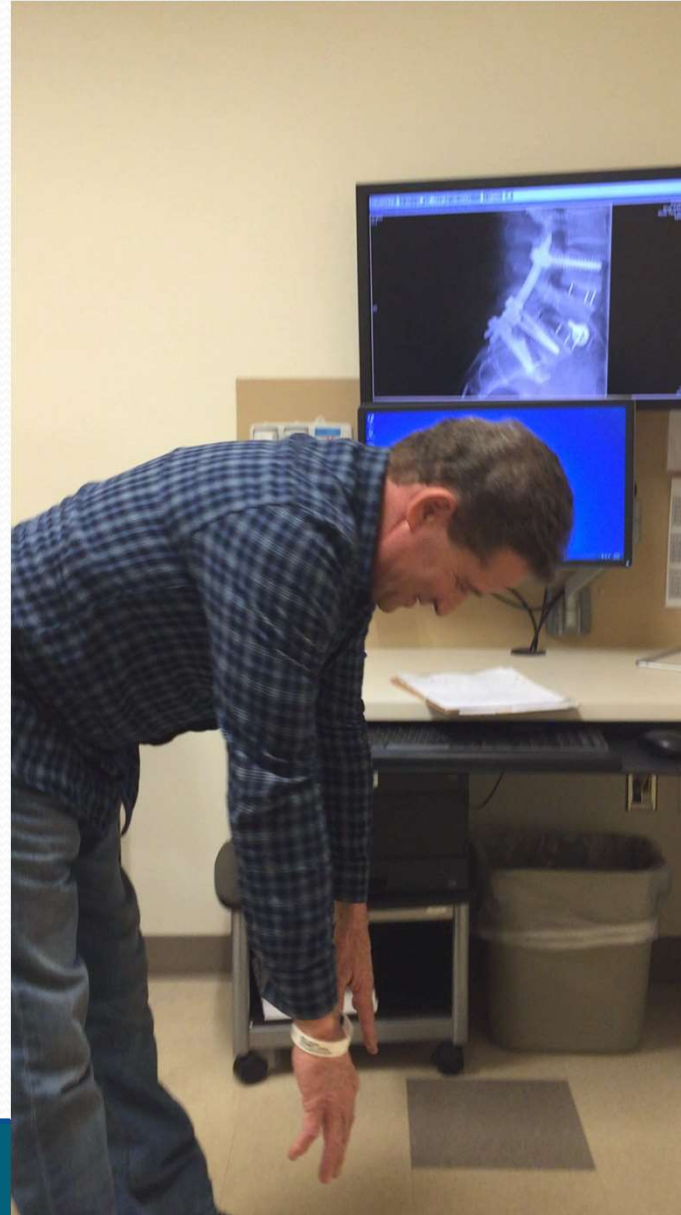
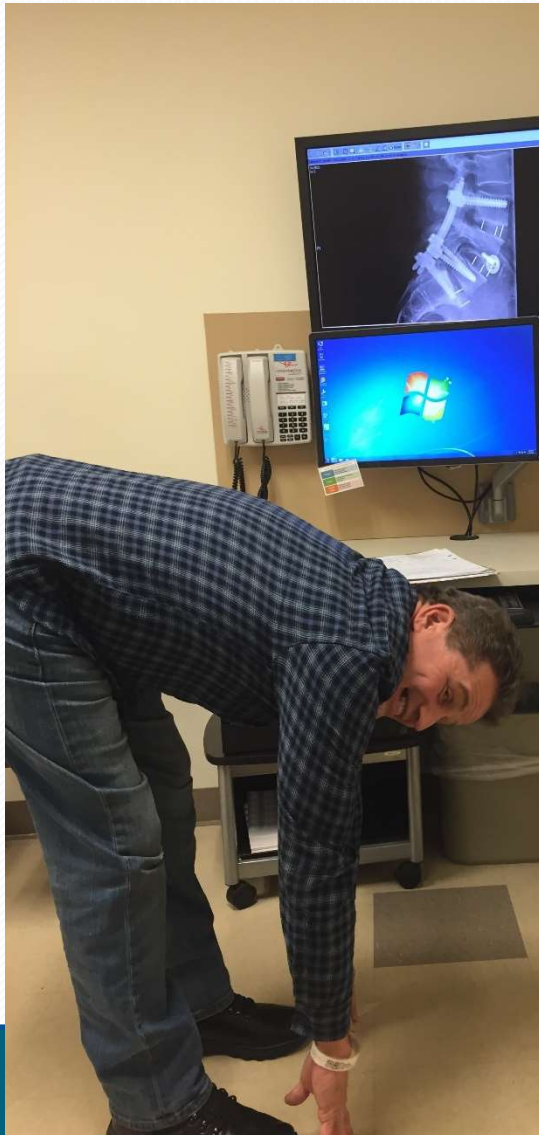
Treat the Entire Disease



Simple
Discectomy



4 weeks post L3-S1 fusion



Decompression next to fusion:



06-2009

Use of Novel Techniques



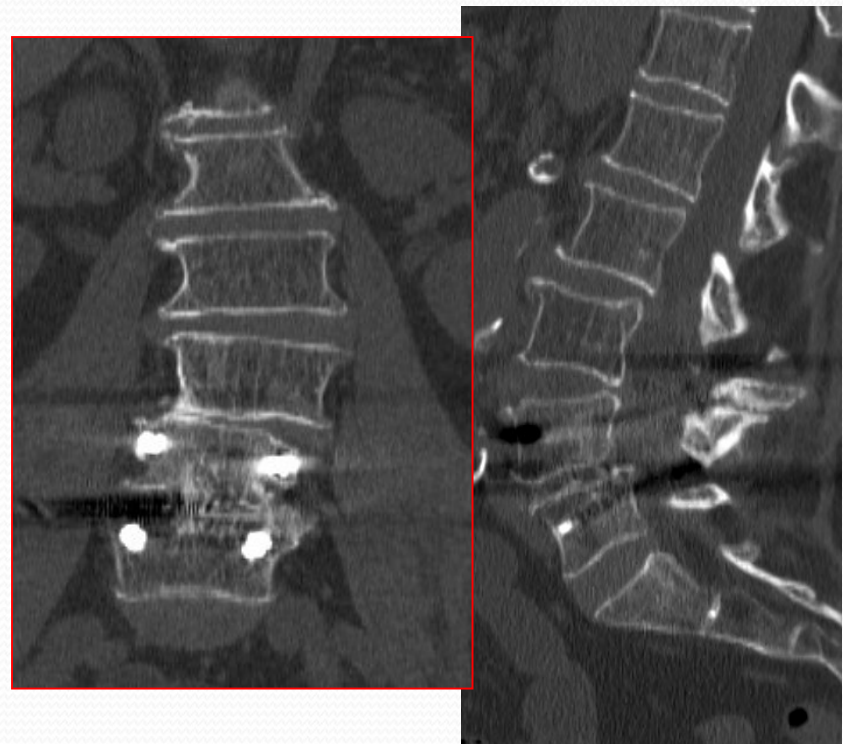
Two week F/U

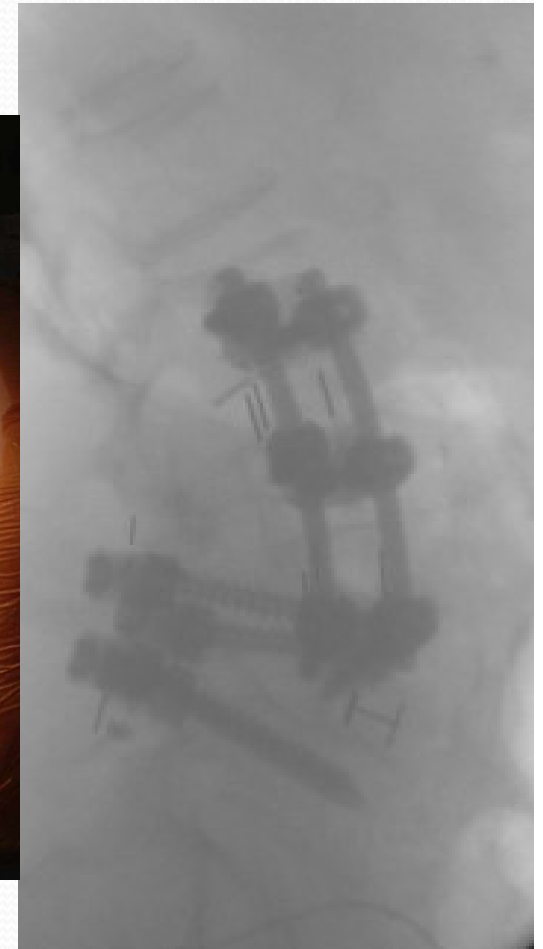
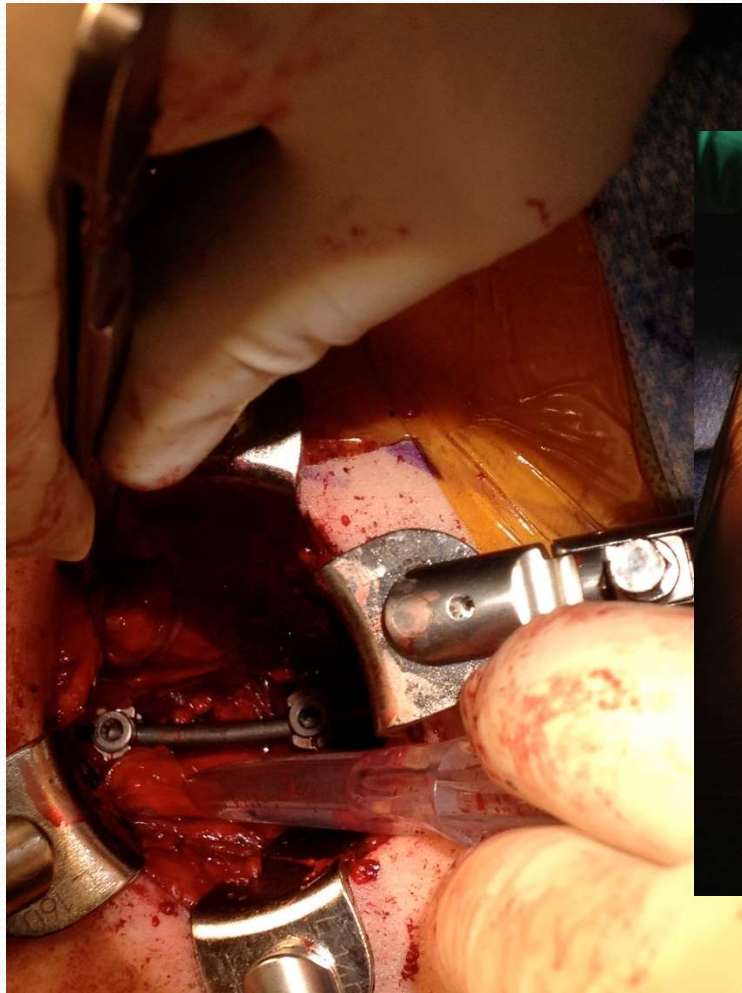
Use of Targeted Rx

- 63 yo lady
- S/P 3 Spinal surgeries

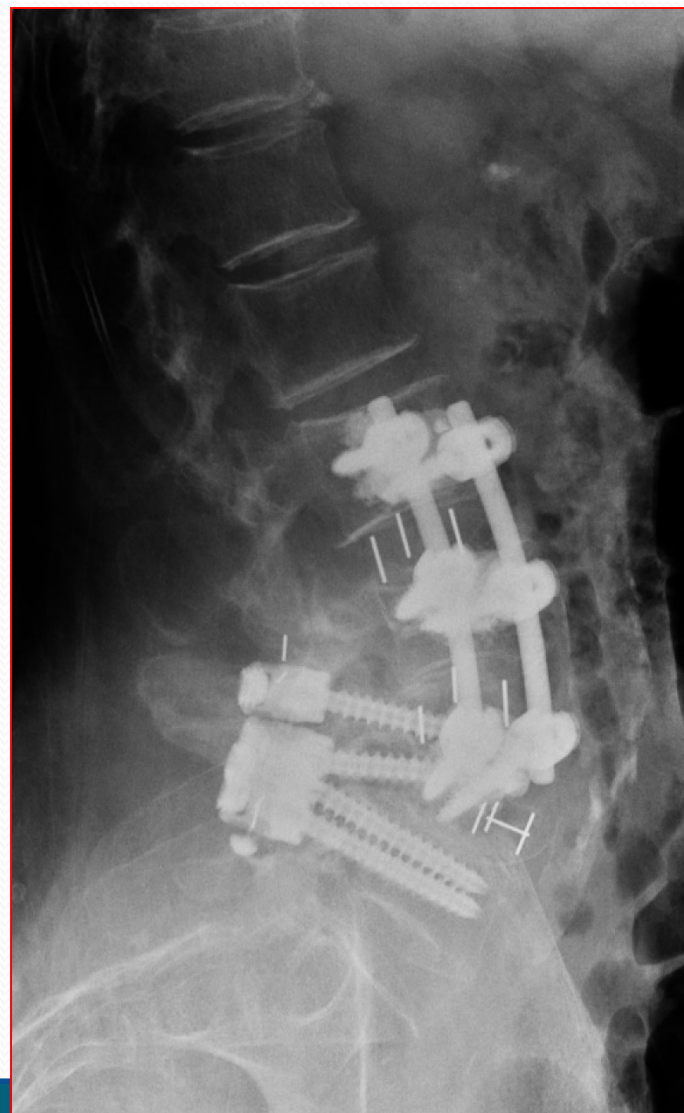
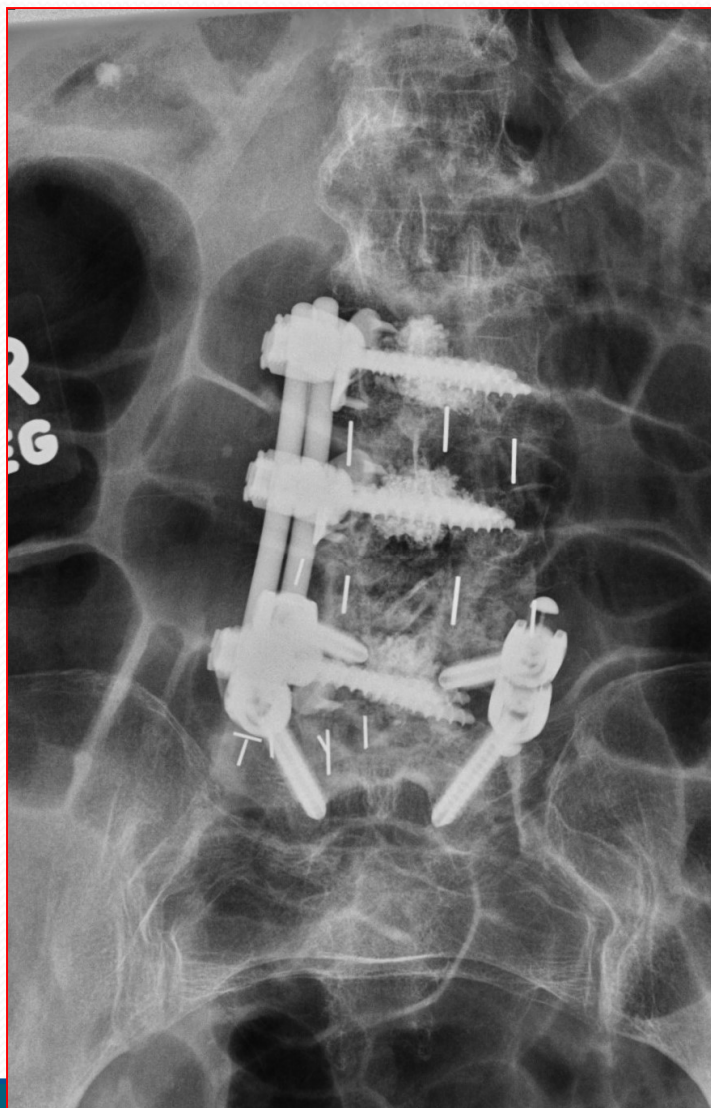


CT and MRIs





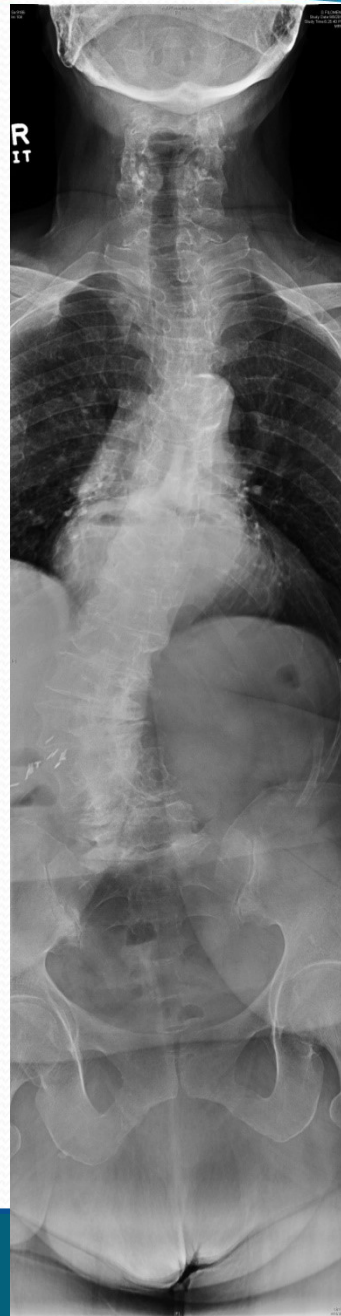
18 months Post Op

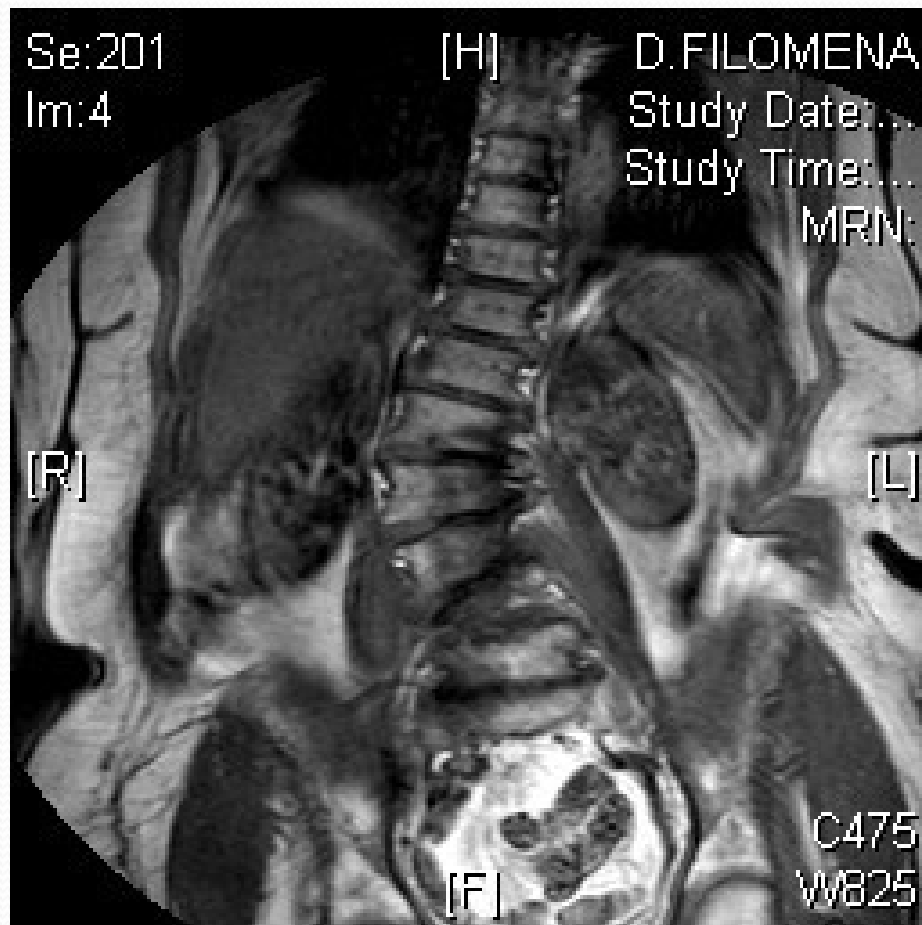


NOVEL TECHNIQUES

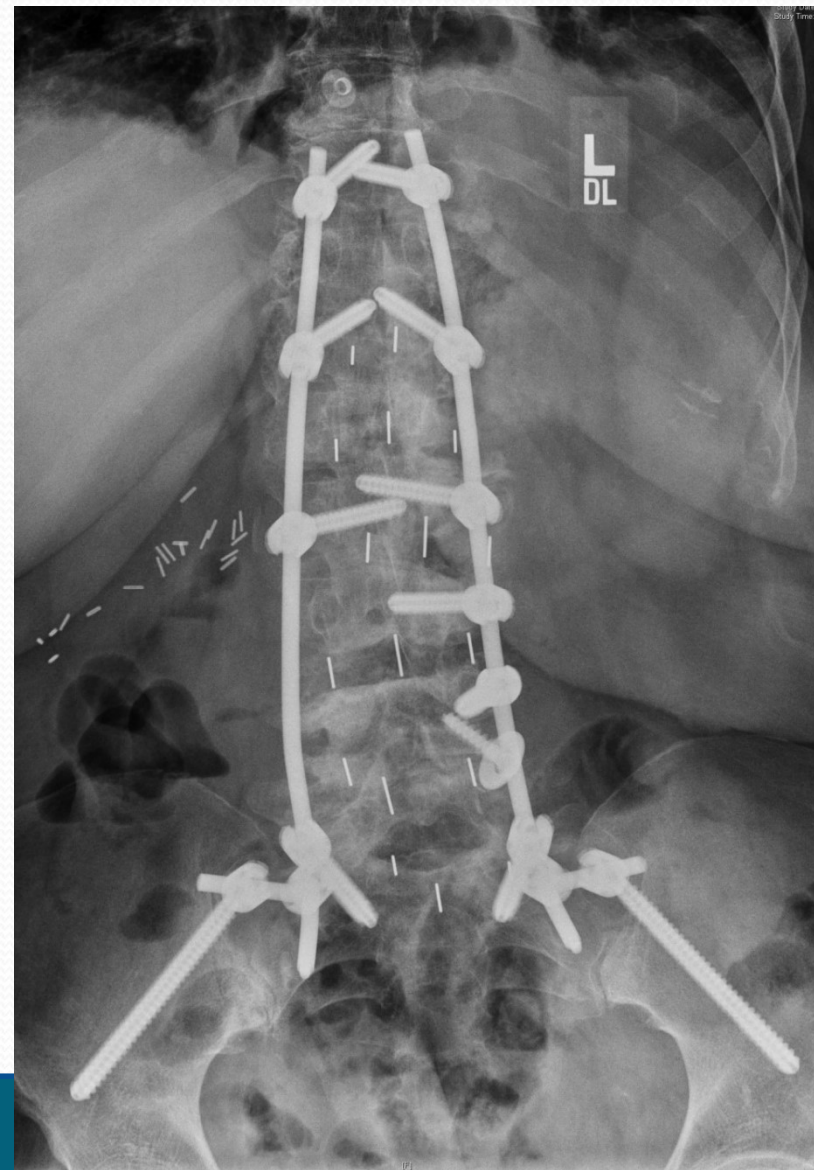
Felomina: 65 yo lady







Ant:T12-S1 Anterior Post: T10-S1+ Iliac Fixation



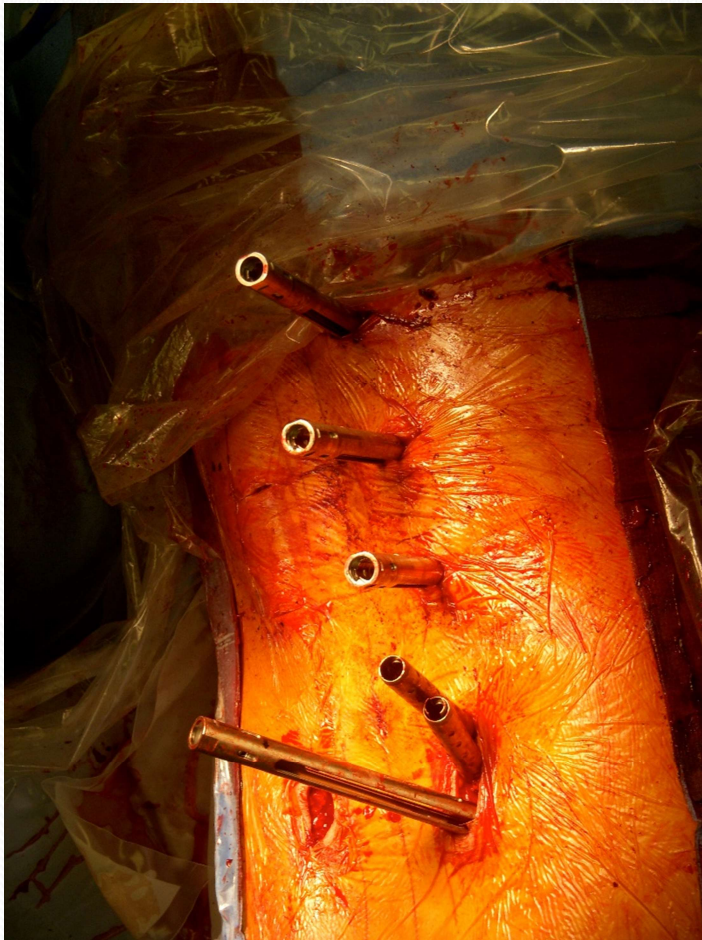
Before and After



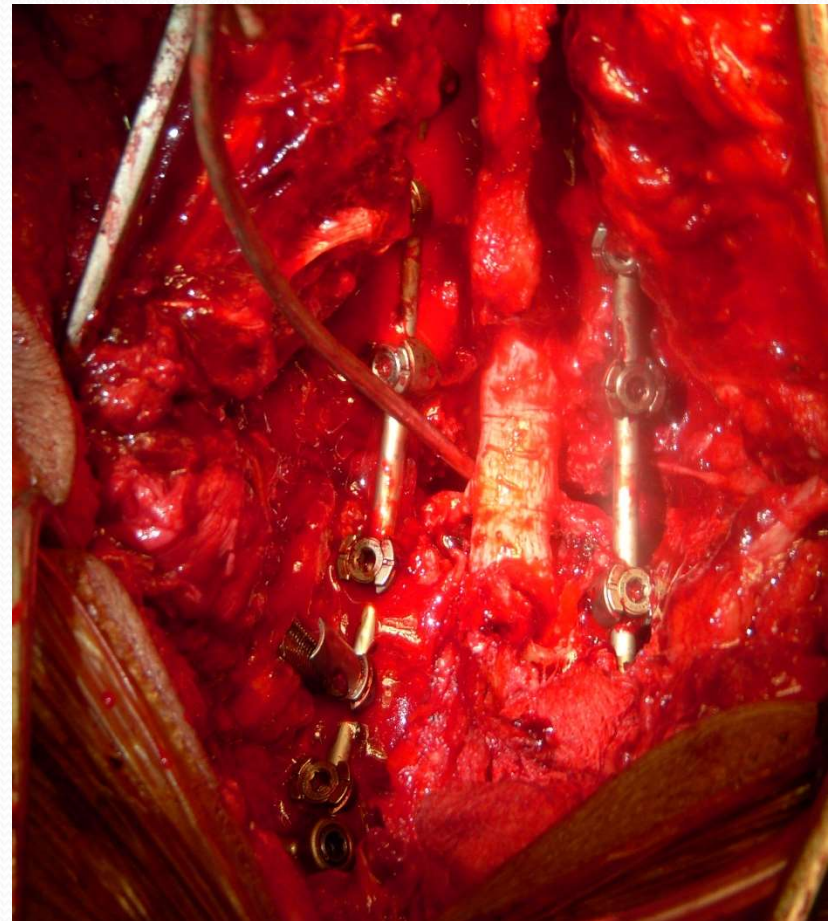
ADJACENT SEGMENT DISEASE: IATROGENIC

MIS vs Open

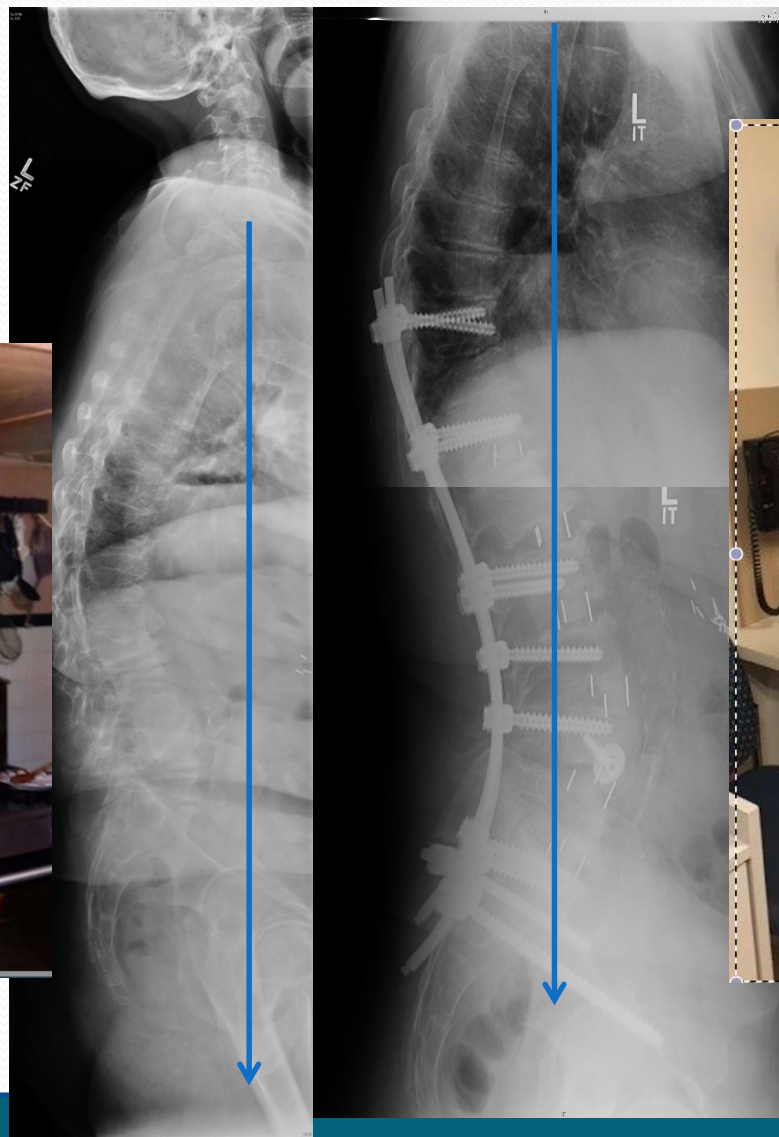
MIS Technique



Open/Standard approach



Sagittal balance





Take home message

- Back pain still ill-understood
- There's potential for great success and reward if we understand the pain source
- Novel techniques are helping
- BIOMECHANICS, BIOMECHANICS...